3 - 5 Train Handling in New Delhi and Delhi Stations

New Delhi and Delhi are the main passenger terminals of the Delhi area. The number of trains to be dealt with in these stations will continue to increase even after 1994-95 (Action Plan).

It is also expected that these stations will have to deal with longer trains, since the train consist will be lengthened from 17 ~ 18 to 22 and 26. Consequently, in order to cope with the above-mentioned, it will be necessary for these stations to secure platforms, washing lines, stabling lines and sick lines improved in length and in number.

3 - 5 - 1 Present Status of New Delhi and Delhi Stations

3 - 5 - 1 - 1 New Delhi Station

(1) Number of trains dealt with and present status of platform utilization

1) Number of trains (as of Nov. 1, 1988)
Present status of train handling is shown platform-wise in Table 3.5.1-1.

2) Platform length
The length of platform is capable to deal with 15 ~ 22 cars at present. It is necessary to lengthen or newly construct the platforms to accept the 26 car-consist trains.

3) Present status of platform utilization
The present status of utilization of the platform Nos.1-9 is shown in Table 3.5.1-2. The occupancy rate is approximately 48%.

Table 3.5.1-1 Number of Trains treated-New Delhi

Platform	Number of trains				
	Arrival (A)	Departure (B)	Turning back (C)	Through (D)	Total
1	4	4	2	11	21
2	2	4	2	14	22
3	0	0	2	21	23
4	1	1	0	10	12
5	3	4	2	2	11
6	3	6	1	1	11
7	5	1	1	0	7
8	4	2	1	0	8
9	2	4	0	2	8
10	1	0	0	1	2
11	1	0	0	1	2
1 ～ 9	24	26	11	61	122
10～11	2	0	0	2	4
Total	26	26	11	63	126

Note: "Number of trains treated" is counted in the following way:

Arrival and Departure trains.
A train arrives at the platform (See A in the graphic). This is counted as one train. Then it will move to washing line or stabling line and then it will be set at the platform again (See B) as a Departure train. This is counted as another train.

Turning back train.
A turning back train is counted as one train (See C).

Through trains.
Each of the up train and down train using the platform is counted as one train (See D).

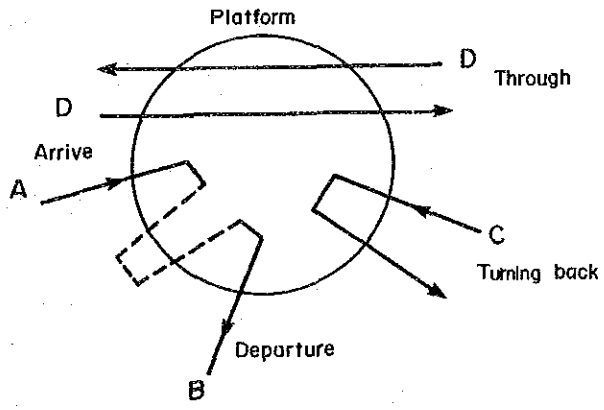
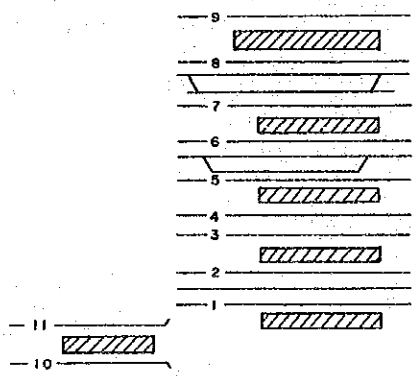


Table 3.5.1-2 Present Status of Platform Utilization-New Delhi

Platform No.	Length number of coaches acceptable	Number treated	Occupancy time 0 −24:00 Ⓐ (Min.)	Average occupancy time per train (Min.)	Occupancy rate Ⓐ÷1440×100 (%)
1	19	21	861		
2	18	22	709		
3	18	23	722		
4	22	12	609		
5	22	11	582	—	—
6	22	11	925		
7	22	7	620		
8	22	7	650		
9	22	8	565		
Subtotal	—	122	6,243	51	48
10	15	2	357	—	—
11	16	2	455		
Subtotal	—	4	812	203	28
Total	—	126	7,055	—	45

Note : The time of platform occupancy consists of trains' stopping time and the time of occupying the departure/arrival lines for excess/egress to/from the platform. An extra of 5 minutes is added for each of the excess and egress.



In general, when the rate of occupancy of a platform per day reaches 50 ～60%, the train operation planning becomes difficult. When it reaches 60 ～ 70%, it becomes almost unable to increase the number of trains during the effective time zone. Consequently it can be said that New Delhi station is reaching the limit in number of platforms.

(2) Present status of washing and stabling lines utilization

1) Numbers and length of the lines

New Delhi station has, at present, 8 washing lines, 7 stabling lines and 1 engine run round line, 16 lines in total.

Their line lengths are disigned for the trains of 9 ～ 24 car-consist. Only the engine line has the length for the trains of 22 or more car-consist. In case of handling a long train, they are devided into some parts. This complicates the shunting works. It is essential in the improvement of New Delhi Station to make them longer to accept 22-26 cars.

2) Present status of utilization

The status of washing and stabling lines utilization is shown in Table 3.5.1-3. Some washing lines and stabling lines are laid between and in parallel to the platforms. This complicates the shunting work.

These situations are explained in Table 3.5.1-3.

(3) Others

1) Engine waiting line

This station is a boundary station between the electrified and non-electrified sections. At an average, 25 trains per day change here their locomotives from electric to diesel or vice versa. For this loco changing operation, most of the locomotives have to use the main line for waiting, complicating the shunting work. Installation of an engine waiting line is

required on the Tilak Bridge side.

2) Restrictions in running speed

The atual types of turnouts installed in this yard restriot the train's running speed severely, and this results in the increase of the running time between stations and decrease in the line capacity.

The longer a train will become, the more the situation will be worsend. Improvement of turnouts is required.

Table 3.5.1-3 Present Status of Washing and Stabling Lines Utilization-New Delhi (Nov.1, 1988.)

Line	Length in number of coaches accept-ed	Washing			Stabling		Total			To be removed in the first construction step
		Times per day of utiliz-ing the line	Time of occupancy (Min.)	Average time per train required for washing (Min.)	Times per day of utiliz-ing the line	Time of occupancy (Min.)	Times per day of utiliz-ing the line	Time of occupancy (Min.)	Average time per train required for washing (Min.)	
W－1	21	4	1.050		3	180	4	1.230		△
W－2	19	2	420		2	195	2	615		△
W－3	16	2	705		1	90	2	795		
W－4	16	2	240		2	30	2	270		
W－5	9	1	120		2	410	2	530		
W－6	21	4	780		2	550	4	1.330		△
W－7	21	① 4	960		① 4	225	4	1.185		△
W－8	21	(3) ① 5	(570) 1.050		(3) ① 5	(400) 550	(3) 5	(970) 1.600		△
Subtotal	144	(22) ㉓ 24	(4.845) 5.325	㉜	⑳ 21	(2.080) 2.230	(23) ㉓ 25	(6.925) 7.555	㉙	
E L	24	1	210		(2) 3	(485) 680	(2) 3	(695) 890		△
STB －1	20	－			1	240	1	240		△
STB －2	15	－			1	315	1	315		△
STB －3	17	1	210		1	450	1	650		△
STB －7	21	0			0		0	0		△
STB-7A	10	0			0		0	0		△
STB －8	21	－			1	540	1	540		△
STB －9	21	－			1	510	1	510		△
Subtotal	149	2	420		(7) 8	(2.540) 2.735	(7) 8	(2.960) 3.155		
Total	293	㉕						(9.885) 10.710	(396) 429	

Note

Times	
(3)	····· The line deals with two or more trains at a time. This case takes place 3 times a day.
①	····· One train is divided into two to be treated in the line. This case takes place once a day.
5	··· The line deals with a whole or part of train 5 times a day.
Subtotal (22) ㉓	····· 23 actual trains are washed. One of them is divided into two to be washed.
24	··· Therefore the washing lines deal with a whole or part of trains 24 times per day.

3 - 5 - 1 - 2 Delhi Main

Delhi Main has facilities for both broad and metre gauge lines.

(1) Number of BG trains dealt with and the present status of platform utilization.

1) Number of trains

Present status of train handling is shown platform-wise in Table 3.5.1-4.

2) Platform length

Excepting the platforms No.1 and 2, ten platforms (Nos 3 through 12) are used in two partitions. The number of cars acceptable at one platform is, therefore, 12 ~ 15. Platforms Nos 13 through 16 are dead-ended. Their acceptability is 8 ~ 11 cars. 14 trains of long formation occupy the arrival/departure lines at the same time.

When the number of cars of a train becomes 22 or 26, there is no platform which has enough length for accepting them. A pair of the platforms Nos 3 through 12 will have to be used for dealing with one train. As a result, the track occupancy rate will greatly increase.

3) Present status of platform utilization

The present status of platform utilization is shown in Table 3.5.1-5. As for the platform No.1~12, the occupancy rate is about 47%. nearing the limits.

(2) Present status of washing and stabling lines utilization

1) Number and length of lines

This station has 4 washing lines and 4 stabling lines. The longest washing line is for 14 cars. While the stabling lines are able to deal with 22 ~24 cars.

2) Present status of utilization

Present status of washing and stabling lines utilization is shown in Table 3.5.1-6.

(3) Number of MG trains handled and present status of platform utilization.

1) Number of trains

Present status of train handling is plaftorm-wise shown in Table 3.5.1-7.

2) Platform length

Platform lengths are apt for 17-20 cars.

3) Present status of platform utilization

Platform utilization is shown in Table 3.5.1-5. The occupancy rate is about 45%. There is still room for further utilization.

4) Others

MG tracks have two surface crossings with BG tracks at the western exit of the station.

The more the BG trains increase, the more difficult it will become to set up MG trains.

Table 3.5.1-4 Number of BG Trains treated-Delhi

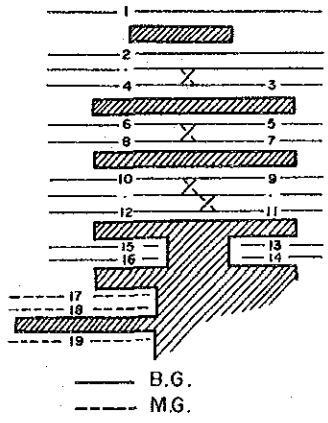
Platform	Number of trains									
	Arrival		Departure		Turning back		Through		Total	
1		4		1		1		3		9
2		3		1		2		4		10
3		3		2		2		6		13
4		4		1		2		1		8
5	[1]	2		1		3	[2]	2	[3]	8
6	[1]	1		1		1	[2]	2	[3]	5
7	[1]	2	[2]	2		2	[2]	2	[5]	8
8	[1]	1	[2]	5		1	[2]	2	[5]	9
9		1		2		2	[1]	3	[1]	8
10		1		1		2	[1]	3	[1]	7
11		3		1	[1]	3	[4]	4	[5]	11
12		2		0	[1]	2	[4]	8	[5]	12
Subtotal	[4]	27	[4]	18	[2]	23	[18]	40	[28]	108
13		0		6		0		0		6
14		0		1		0		0		1
15		0		3		0		0		3
16		0		1		0		0		1
Subtotal		0		11		0		0		11
Total	[4]	27	[4]	29	[2]	23	[18]	40	[28]	119

Note: Figures in brackets [ ] show the breakdown of the number of trains which occupy the two arrival/departure lines simultaneously.

Table 3.5.1-5 Present Status of Platform Utilization-Delhi

Platform No.	No. of coaches can be accommodated	No. of trains	Occupancy time 0 −24:00 Ⓐ (Min.)	Average occupancy time for train (Min.)	Occupancy rate Ⓐ÷1440×100 (%)
1	17	9	862		
2	18	10	678		
3	14	13	590		
4	14	8	512		
5	14	8 [3]	820		
6	14	5	635	—	—
7	14	8 [5]	775		
8	13	9	720		
9	15	8 [1]	667		
10	12	7	607		
11	14	11 [5]	650		
12	14	12	639		
Subtotal	—	[14] 108	8,155	76	47
13	10	6	440		
14	8	1	105	—	—
15	11	3	375		
16	11	1	90		
Subtotal	—	11	1,010	92	24
Total	—	[14] 119	9,165	—	40
17	20	9	535		
18	18	12	640	—	—
19	17	11	770		
Total	—	32	1,945	61	45

Note : Figures in brackets [ ] show the breakdown of the number of trains which occupy the arrival/deparure lines simultaneously.



Present State of Platform Tracks

Table 3.5.1-6 Present Status of Washing and Stabling Lines Utilization-Delhin (Nov. 1, 1988.)

Line name	No. of coach	Working			Stabling			Total			Remarks
		Times	Occupancy time (Min.)	Average time per day (Min.)	Times	Occupancy time (Min.)	Average time per day (Min.)	Times	Occupancy time (Min.)	Average time per day (Min.)	
W－1	13 + 1	① 3	570		① 2	90		① 3	660		
W－2	13 + 2	2	900		2	240		2	1,140		
W－3	12 + 1	① 3	1,080		① 3	210		① 3	1,290		
W－4	14 + 2	2	750		2	750		2	1,170		
19	22 + 1	4	990		2	210		4	1,200		
20	22 + 1	4	810		1	30		4	840		
21	23 + 1	4	750		2	90		4	840		
22	24 + 1	2	390		1	180		3	570		
Total		(23) 24	6,240	(272)	(14) 15	1,470	(105)	(23)	7,710	(335)	

Note : See note to Table 3.5.1-3

Table 3.5.1-7 Number of MG Trains treated-Delhi

Platform No.	Number of trains				
	Arrival	Departure	Turning back	Through	Total
17	6	3	0	0	9
18	7	5	0	0	12
19	4	7	0	0	11
Total	17	15	0	0	32

3 - 5 - 1 - 3 H.Nizamuddin

(1) Number of train's handled and present status of platform utilization.

1) Number of trains

This station is an auxiliary terminal in Delhi area to deal with Mail/Expresses bound for Mathura and a departure/arrival terminal of EMU on Ring Line. On top of it, 4 through Mail/Expresses up trains and 18 down trains are operated which pass through this station.

Table 3.5.1-8 Number of Trains treated - H.Nizamuddin

Platform No.	Number of trains				
	Arrival	Departure	Turning back	Through	Total
1	4	4	4	1	13
2	0	0	0	26	26
3	1	0	0	15	16
4	1	4	0	5	10
Total	6	8	4	47	65

2) Platform length

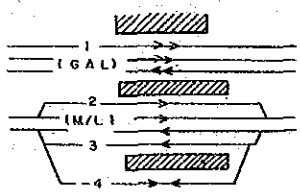
EMU trains use No.1 platform exclusively. This platform is apt for 9 cars, and No.2 and No.3 platforms are apt for 21 and 15 cars, respectively. No.4 platform is for 17 cars. It can be used either for up-train's or for down-train's arrival/departure.

3) Present status of platform utilization

Present status of platform utilization is shown in Table 3.5.1-9. The occupancy rate is about 24%, because a stopping time of the trains is shorter than that of New Delhi and Delhi stations.

Table 3.5.1-9 Present Status of Platform Utilization-H.Nizamuddin

Platform No.	No. of coaches can be accommodated	No. of trains	Occupancy time 0－24:00 Ⓐ (Min.)	Average occupancy time for train (Min.)	Occupancy rate Ⓐ÷1440×100 (%)
1	9	13	276		
2	21	26	365	——	——
3	15	16	227		
4	17	10	520		
Total	——	65	1,388	22	24



Present State of Platform Tracks

(2) Present status of washing and stabling lines utilization - Number and length of lines

This station has 2 washing lines, one sick line and 5 stabling lines. Furthermore, 3 stabling lines for EMU are installed. These lines are apt for 9 cars.

Table 3.5.1-10 Present Status of Washing and Stabling Lines Utilization-H.Nizamuddin (Nov. 1, 1988.)

Line name	No. of coach	Working			Stabling			Total			Remarks
		Times	Occupancy time (Min.)	Average time per day (Min.)	Times	Occupancy time (Min.)	Average time per day (Min.)	Times	Occupancy time (Min.)	Average time per day (Min.)	
14 (WL)	18	3	570		—			3	570		
15 (WL)	17	2	300		—			2	300		
16 (SL)	7	—			—			—	—		Sick line
9	23	—			1	360		1	360		
10	22	—			1	1,440		1	1,440		
11	10	—			1	1,440		1	1,440		
12	22	—			1	600		1	1,440		
13	20	—			1	575		1	575		
Total	—	5	870	174	5	4,415	883	10	5,285	529	

3 - 5 - 2 Terminal Capacity

3 - 5 - 2 - 1 Train Handling Plan (Earlier Period)

The requirement and the operability of the trains in the lines/sections exterior to Delhi area have been studied in the preceding paragraphs under 3.3. As the results, the number of trains to be treated at New Delhi and Delhi stations have been obtained as is given in Table 3.3.2-12.

The aim of this paragraph 3-5-2 is to determine what kinds of facilities will be required for New Delhi Station to deal with these trains, It is assumed here that certain trains which would exceed the Delhi's present capacity to treat them will be allocated to and accepted by New Delhi.

(1) Preconditions for calculation

Now it must be determined how many trains can be treated by Delhi Main with its existing facilities, and then how many of them will have to be reassigned to New Delhi. In determining them, the following assumptions are made ;

1) Types of train handling

Some trains originate and terminate their services in the areas exterior to Delhi area, and pass Delhi/New Delhi. Some trains turn back at Delhi or New Delhi. Other trains originate and terminate their services at Delhi/New Delhi. The types of the handling work are quite different among these trains. In this Study, as a matter of principle, the trains to be newly set up heretofore will be planned terminating and originating in the Delhi area. Since the maintenance and repairing works are supposed to be made in at Delhi area because of shortage of washing/repairing equipments in the outer areas.

2) Occupancy of the arriving/starting lines

The time length(T) for a train to utilize the arriving/starting line is assumed to be given by a formula below:

$$T = T_1 + T_2 + T_3$$

Where: T_1 = Average time for a train staying at the line. It is considered the same as at present: 40 minutes at New Delhi and 60 minutes at Delhi Station.

T_2 = Time required for a train to be set at the line, plus, 5 minutes of allowance

T_3 = Time required for a train to clear the line, when it leaves, plus, 5 minutes of allowance

3) Capacity of arriving/starting lines

Their capacity is calculated according to a simplified method. The method is generally used for the preliminary steps of its improvement planning. Their capacity should be calculated more accurately with actual train diagrams and yard work programs in later steps.

4) Capacity of platforms

The capacity of a platform facing an arriving/starting line is calculated in terms of the number of trains the platform can accept per day. There, the following assumptions are made.

—— The maximum time length during which a platform can be utilized is 720 minutes a day, or 50%(=0.5) of 24 hours (1440 minutes).

—— The time length of a platform utilization counts from the time point when the train gets into the arriving line, stays at the platform and ends at the point when it leaves the starting line.

(2) Allocation of Trains to Delhi and New Delhi

It is assumed that the trains overflowing Delhi Main should be treated at New Delhi. Therefore the number of trains acceptable at Delhi Main is first to be estimated. Then it is verified if the overflowed trains could be treated at New Delhi. The verification criteria are the capacity of their platforms, washing/stabling lines.

1) Platforms

a. Delhi Main

(a) Future requirements of platforms

The platform No.1 of Delhi Main is designed for accommodating 17 passenger cars, platform No.2 for 18 cars, and platforms No.3 through 12 for 12 to 15 cars. Even at present there are 14 trains with the formation of more than 19 cars. In order to accommodate them two platforms are used.

It is envisaged in Action Plan for Delhi to accept six more Mail/Expresses with 26 car-consist. And ten more with 22 car-consist. There will be more Local Passenger trains of 18-22 car-consist according to Action Plan.

It is generally desirable in Delhi area that the traffic capacity be augmented by lengthening the formation of a train. It is because the number of trains operable in this area is restricted due to the limited line capacity of the related lines in the outer circle.

But this rule should not apply to Delhi Main. Because, at this Station, when longer trains increase, two of the arrival/departure lines (Nos 3 through 12) will have to be assigned for one train at a time. This would lessen the number of trains operable at this Station. Except for the longer trains Action Plan assings to Delhi Main, therefore, planning efforts are paid to concentrate as many shorter

trains (of 12 to 14 cars) as possible to Delhi Main. Planning efforts are also paid to increase its arrival/departure/stabling capacity as large as possible, by modifying the existing MG arrival/departure lines for BG use. This is in line with Delhi Mains's MG terminal function being moved to Patel Nagar.

(b) Platform capacity

A diagram of the platform utilization is drawn (Fig.3.5.2-1), representing its actual state of Nov. 1, 1988 as reported. It is then modified considering the requirements when Action Plan is completed(Fig.3.5.2.2). This diagram tells that the utilization rate will reach 57%. This means that platforms at Delhi Main will reach the capacity limit by 1994 or 1995.

Table 3.5.2-1 Platform Utilization Rate at Delhi Main

(drawn based on Fig. 3.5.2.2)

Platform No.	Treated Number of trains	Occupancy (in minutes)	Percentage
1	9	675	
2	15	742	
3	16	831	
4	15	847	
5	7	820	
6	4	830	
7	12	887	
8	12	842	
9	15	885	57
10	13	1,057	
11	8	372	
12	9	977	
Total	135	9,845	
Average per train		73	

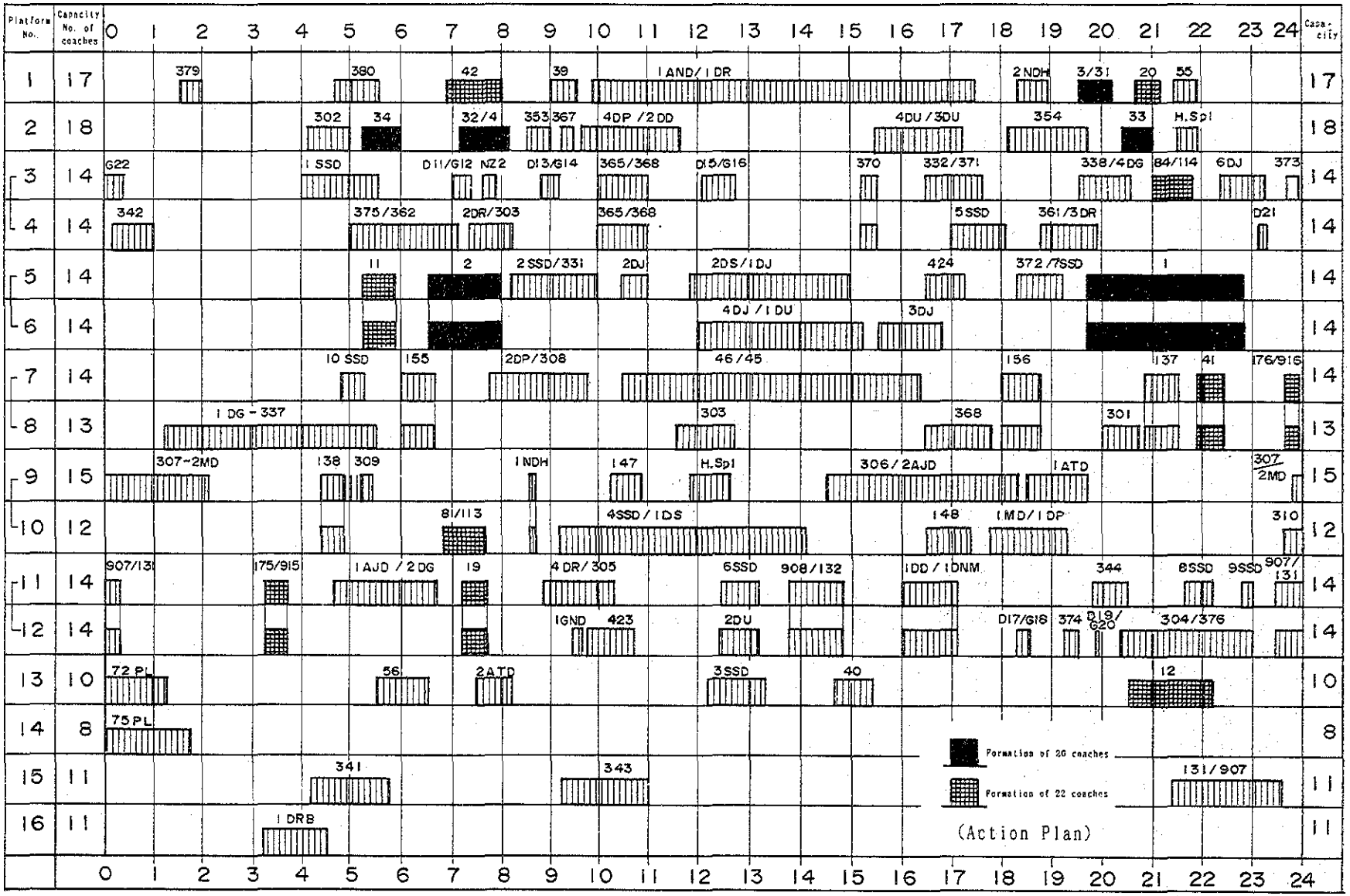


Fig. 3.5.2-1 Platform Utilization in Delhi Station in 1988-89 (Nov.) and in 1994-95 (Action Plan)

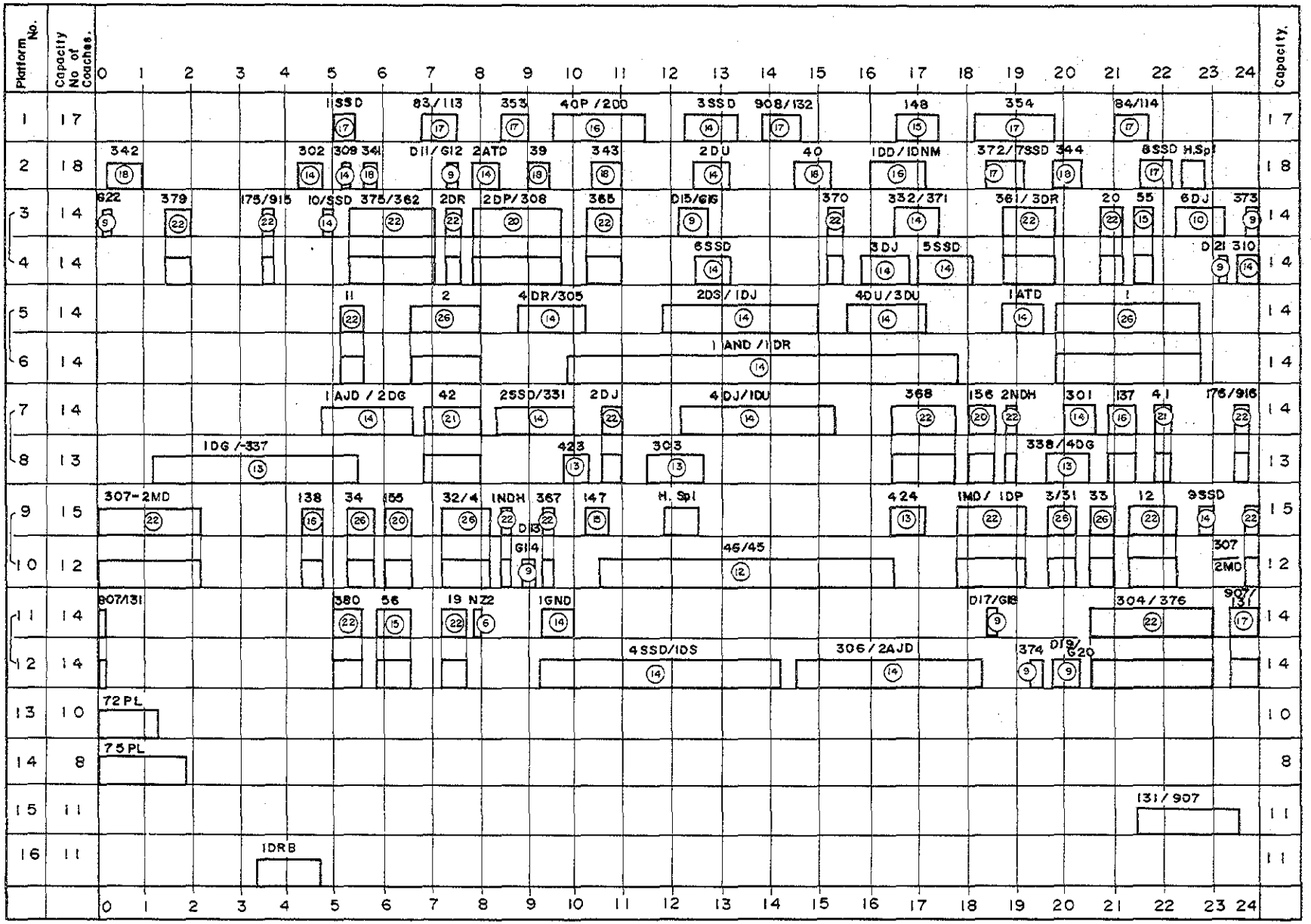


Fig. 3.5.2-2 Platform Utilization in Delhi Station in 1994-95 (Modified Action Plan)

(Figures in a circle show a formation of trains.)

(c) Measures increasing the capacity of arrival / departure / stabling lines at Delhi Main

The existing three arrival/departure lines of a dead-end type at Delhi Station are for MG use. They will be modified for BG use by 1999-2000. The effective-length will be 18 car-consist passenger trains, but of the same dead-end type. The difficulties with them are: 1) they have to be used both for EMU and loco hauled trains. This mixed use will make the utilization rate poorer. 2) routes are open only for the directions: NDLS, SSB and NDAZ. But as a whole, they will enable Delhi Main to deal with about twenty additional incoming or outgoing trains.

Table 3.5.2-2 Increase in Number of Incoming or Outgoing Trains by Modification of MG Arrival/Departure Linees to BG Use

Item	Number of trains treated				Number of incoming or outgoing trains
	(A)	(B)	(C)	(D)	(E)
	terminating trains	originating trains	turning back trains	total	= A + C or = B + C
Percentage in number	36	36	28	100	—
Sets	11	11	9	31	20

Note: The arrival/departure line capacity is evaluated here in terms of "incoming or outgoing trains", because the lines in question are dead-end type.

b. New Delhi

(a) Future requirement of platforms

Platforms of New Delhi at present are apt for accepting trains of 18 to 22 car consist. The Action Plan will assign to New Delhi 12 more 26-car consists and 30 more 22-car consists for the Mail/Express. In addition, the number of cars in local passenger trains will be increased gradually to the 18- to 20-car consists range. Platforms must be longer.

In contrast to Delhi Main, New Delhi should be specialized for longer trains. An allocation of trains should be made in terms of their length, so that the total number of trains handled at both stations could be maximized. Platforms to be additionally built at New Delhi must be designed for 26 car trains.

(b) Number of future incoming or outgoing trains at Delhi Main and New Delhi

The number of future incoming or outgoing trains at Delhi Main which was worked out according to the Transportation Plan must be reviewed considering the capacity of arrival/departure lines at Delhi Main as studied in the preceding paragraph. It is as shown in Table 3.5.2-3.

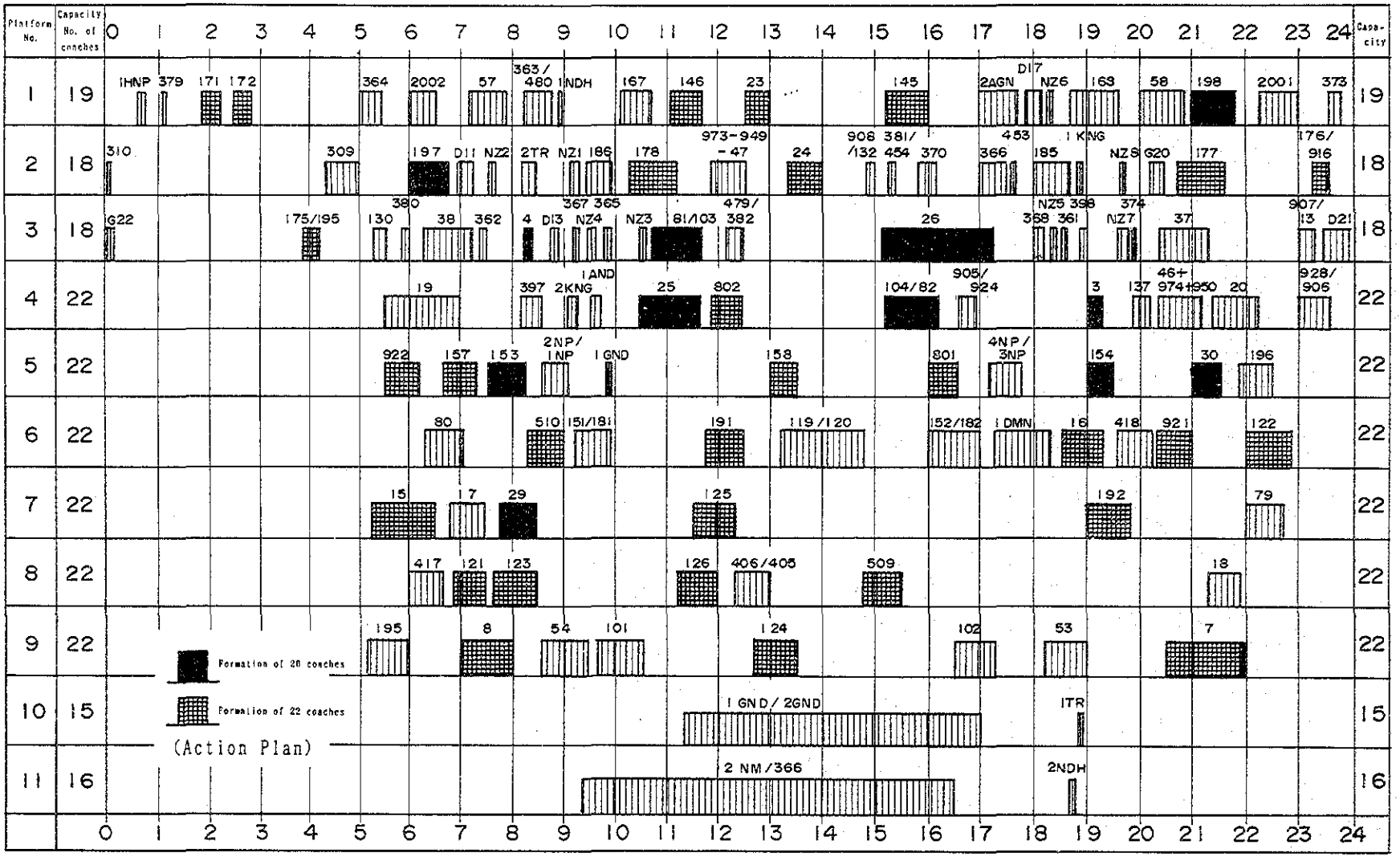


Fig. 3.5.2-3 Platform Utilization in New Delhi Station in 1988-89 (Nov.) and in 1994-95 (Action Plan)

Table 3.5.2-3 Number of Future Incoming or Outgoing Trains at DLI and NDLS

Station	Year	For GZB		For TKD		For DLI or DSA		For NDAZ	For SSB	Total	
New Delhi	1988 Nov.	15 6 21		20 18 38		5 14 19		8 4 12	4 6 10	52 48 100	
	1994 ~ 1995	17 9 26		21 24 45		5 17 22	5 22 27	8 4 12	4 9 13	55 63 118	55 68 123
	1999 ~ 2000	23 10 33	28 12 40	21 24 45		5 17 22	5 22 27	8 4 12	5 9 14	52 64 126	67 71 138
Delhi	1988 Nov.	13 18 31		5 13 18		1 6 7		2 5 7	1 10 11	22 52 74(77)	
	1994 ~ 1995	13 26 39		5 16 21	5 21 26	1 6 7		3 8 11	1 12 13	23 63 91 (94)	23 73 96 (99)
	1999 ~ 2000	18 28 46	13 26 39	5 16 21	5 21 26	2 6 8		5 9 14	1 12 13	31 71 102 (105)	26 74 100 (103)
Total	1988 Nov.	28 24 52		25 31 56		6 20 26		10 9 19	5 16 21	74 100 174(177)	
	1994 ~ 1995	30 35 65		26 40 66	26 45 71	6 23 29	6 28 34	11 12 23	5 21 26	78 131 209 (212)	78 141 219 (222)
	1999 ~ 2000	41 38 79	41 38 79	26 40 66	26 45 71	7 23 30	6 28 35	13 13 26	6 21 27	93 135 228 (231)	93 145 238 (241)

Note : 15 ----- Mail/Express
6 ----- Local Passenger
21 ----- Total

74 (77) ----- including 1 holiday special
2 parcel trains

Note 2 : When a box in the above table is divided into two smaller boxes (as in"Total-1994-95"), the figures in right hand boxes denote the number of trains reviewed. 1) Making the trains now originating, terminating at DLI, Pass it. 2) Modifying of the M.G arrival/departure lines at Delhi Main for B. G use.

Local Passenger train operation is extended to New Delhi in 1994-95 in order to shorten their stopping time.

Seven incoming or outgoing trains were transfered from DLI to NDLS in 1999-2000 .

(c) Required number of platforms at New Delhi

Considering the lengthened train consist and considering the minimization of the train maintenance work at other stations, all the trains are planned to originate/terminate at New Delhi.

In this case the number of trains to be treated at New Delhi is as shown in Table 3.5.2-4.

Table 3.5.2-4 Number of Trains Dealt with at New Delhi

Year	Number of incoming trains	Number of trains handled at platform				
		Termi-nating	Origi-nating	Turning back	Through	Total
1988 Nov.	100	26	26	11	63	126
1994-1995	123	39	39	11	73	162
1999-2000	138	54	54	11	73	192

The required number of platforms is 14 as calculated below.

$$n = \frac{N \times t}{T \times f}$$

Where: n = required number of platforms

N = number of trains which must be treated at New Delhi (192)

t = time length of a train occupying the platform (50 minutes)

T = 24 hours (1440 minutes)

f = maximum total time of platform utilization per day (50% or 0.5)

$$n = \frac{192 \times 50}{1440 \times 0.5} = 14$$

2) Washing and stabling lines

a. Delhi Main

23 trains per day, or about 90% of the 25--27 trains whose service originate and terminate at Delhi Main are maintained (washed or stay overnight) at this terminal. Supposing that this work practice is continued, the number of trains needing maintenance (Nm) at Delhi Main is estimated as shown in Table 3.5.2-5.

Table 3.5.2-5 Number of Trains Treated at Delhi in 1999-2000

Year	Number of incoming trains	Number of trains handled at platform					Remarks
		Terminating	Originating	Turning back	Through	Total	
1988 Nov.	77	27 (4)	29 (4)	23 (2)	40 (18)	119 (28)	
1994-1995	99	30 (4)	32 (4)	23 (2)	56 (18)	141 (28)	Local EMU Through 6 Pc " 10 Terminating 3
1999-2000	103	34 (4)	36 (4)	23 (2)	56 (18)	149 (28)	Improvement of three arrival/departures lines MG ~ BG

Note : Figures in brackets ( ) show the break down of the number of trains which occupy the two arrival/departure lines simulutaneously.

In 1999-2000 about 32-~-34 trains will originate/terminate at Delhi Main. It is estimated that about 90% of them, 29 will be maintained here. A total of ten washing/stabling lines are required for them.

Average time for washing/stabling per train

7710 min. ÷ 23 TRAINS = 335 min.

Average rate of utilization of washing/stabling line

7710 min. ÷ (1440× 8) = 67%

335 min.× 29 = 9715 min.

9715 ÷ (1440× 0.67) = 10 lines

The existing washing/stabling lines at Delhi are 8 in all. Therefore the number of trains whose work lord is equivalent to 2 (=10-8) washing/stabling lines will be transferred to New Delhi.

b. New Delhi

(a) Washing line

Most of 54 trains per day whose service originate and terminate at New Delhi in 1990-2000 are maintained here. The maintenance work will be shortened from 4 hours at present to 3 hours (180 min.) due to the introduction of mechanized washing apparatuses. The total required time is 9720 minutes.

54 trains × 180 min. = 9720 min.

Present average rate of utilization of washing line including washing and stabling time is 65%. Total required utilization time of W-1 to W-8 is 7555 min.

Average time of utilization per line is 944 min.

Average rate of utilization per line

944 min. ÷ 1440 min. = 65%

Suppose that an average time of utilization per one washing line is 944 min. same as the present level and the washing line is used for only washing work, the required number of the washing lines is 10.

9,720 min. ÷ 944 min. = 10.3 ≒ 10 lines

(b) Stabling line

Present average stabling time per train is 190 min. except for a washing time.

Terminating train 26 trains

Stabling time except for a washing time 4,965 min.

A total of average stabling time per train

4,965 min. ÷ 26 trains = 190 min.

Suppose that an average time of utilization per stabling line is 944 min. same as that of the washing line, the required number of the stabling lines is 11.

A total of stabling time

54 trains × 190 min. = 10,260 min.

10,260 ÷ 944 min. = 10.9 ≒ 11 lines

3 - 5 - 2 - 2 Train Handling Plan (Later Period)

(1) Number of incoming or outgoing trains in 2009-10

Based on the traffic projection, the number of incoming or outgoing passenger trains at Delhi Main and New Delhi in 2009-10 is estimated as shown in Table 3.5.2-6. The total is 364 trains per day.

Table 3.5.2-6 Number of Incoming or Outgoing Passenger Trains to Delhi and New Delhi in 2009-10

Station	1.Nov.1988	1994-1995	1999-2000	2004-2005	2009-2010
New Delhi	100	118	140	172	199
Delhi	77	94	108	136	165
Total	177	212	248	308	364

(2) Number of trains treated at arrival/departure lines of Delhi and New Delhi

1) Assumptions

i . Ratio among the number each of the following trains is assumed to stay at the same as in Novemter 1, 1988.
-- originating from DLI NDLS
-- terminating at DLI NDLS
-- turning back at DLI NDLS
-- passing DLI NDLS
-- departmental etc.
All the trains newly created after 1994-95 are assumed to be originating/terminating at Delhi or New Delhi.

ii . Maximum number of incoming or outgoing trains at Delhi Main is assumed to be 103, based on the capacity of the arrival/departure lines of the station.

iii . Maximum number of incoming or outgoing trains at New delhi is assumed to be 157, based on the capacity of the platforms (maximum 16 where the maximum of 230 trains a day can be treated). It is considered possible to install 16 arrival/departure lines at New Delhi. The maximum number of trains which can be treated at the arrival/departure lines is calculated to be 230.

$$N = \frac{n \times T \times f}{t}$$

where: N = maximum number of trains which can be treated
n = number of platforms
T = 24 hours (1440 min.)
f = utilization rate of platforms
t = time length of a train occupying the platform (including the time needed for the train to reach or to leave the platform, each estimated at 5 minutes,

in total 50 minutes.)

$$N = \frac{16 \times 1440 \times 0.5}{50} = 230$$

The number of trains turning back at New Delhi, or passing New Delhi is assumed to be the same as in 1994-95 on one hand, and on the other, all the other trains are assumed to be originating/terminating at New Delhi. Then the number of incoming or outgoing trains will be 157 (maximum).

Table 3.5.2-7 Number of Operable Trains at New Delhi Station

Number of operable trains (arrival/departure line)					Number of incoming trains
Terminating	Originating	Turning back	Through	Total	
73	73	11	73	230	157

2) Number of trains handled platforms at Delhi Main, New Delhi

Number of trains handled at Delhi Main, New Delhi platforms is estimated as shown in Table 3.5.2-8.

Table 3.5.2-8 Estimation of Number of Trains Handled at Platform

Station	Year	Number of incoming trains	Number of trains handled at platform				
			Terminating	Originating	Turning back	Through	Total
New Delhi	2004-2005	205	121	121	11	73	326
	2009-2010	261	177	177	11	73	438
Delhi	2004-2005	103	34	36	23	56	149
	2009-2010	103	34	36	23	56	149
Total	2004-2005	308	-	-	-	-	-
	2009-2010	364					

Note 1: The maximum number of incoming or outgoing trains is assumed to be 103.

Note 2: As to the number of trains treated at Delhi Main platforms, see Note to Table 3.5.1-1, as of Nov. 1, 1988.

3) Number of trains exceeding the arrival/departure line capacity of Delhi, New Delhi

The incoming or outgoing trains are estimated to reach 364 per day in 2009-10, while the capacity stays at 260. 104 trains are suspended.

Table 3.5.2-9 Number of Incoming or Outgoing Trains in Delhi Area

			For GZB	For TKD (For NDLS)	For DLI DSA	For NDAZ	For SSB	Total
Total	Demand	A	131	111	37	43	39	(364) 361
	Terminal capacity	B						△ 104 (260)
	Line capacity	C	△ 33 (98)	△ 28 (83)	-	△ 20 (23)	-	△ 81 (283)
	C - B	D						△ 23

Note 1: "Total" is the total of Delhi Main and New Delhi.

Note 2: Figures in parentheses include the parcel trains and holiday trains.

(3) Conclusion (Later Period)

364 trains will be incoming or outgoing in Delhi area, of which 81 will be suspended at the border of the outer and inner circle, due to the limited line capacity in the outer circle. Out of these 81 trains, 33 of them will be treated at Ghaziabad, 28 at Tuglakabad and 20 at Holambi Kalan. The remaining incoming or outgoing trains will, therefore, be 283. But the total of the capacity treating them at Delhi and New Delhi is limited at 260. So 23 suspended. They have to be dealt with at inner terminals by improving these terminals such as Anand Vihar.

CHAPTER 4 RAILWAY FACILITIES, THEIR ACTUAL STATUS AND IMPROVEMENT

CHAPTER 4 RAILWAY FACILITIES, THEIR ACTUAL STATUS AND IMPROVEMENT

4 - 0 Aims

This chapter aims to identify the required improvements in the line capacity of the related sections to accommodate the transportation plan (Chapter 3). Some of them are already clarified in Action Plan. Others are additional to those planned in it. In the preceding chapter (see 3-2-2 (2)), the number of trains operable in future years for each section of the related lines was estimated. This estimation presupposes the completion of these additional improvement works described in this chapter.

4 - 1 Additional Plans

These additional improvements are classified into two groups:

(1) Those for complying with the requirements of the period from now to 1999-2000 (Earlier Period), and

(2) Those for meeting the requirements of the period from then to 2009-10 (Later Period).

4 - 1 - 1 Earlier Period

The improvement plans for the Earlier Period are proposed, selecting the line capacity increasing projects, based on the following criteria:

(1) Where a considerable difference is already observed between the number of trains required and the number of trains operable, in the lines/sections in question.

(2) Where it is considered that the on-going projects might be critically checked, or even become meaningless, or lose its continuity, if the capacity of the line or section relevant to the projects stays at the existing level or at the improved level planned in Action Plan, and

(3) Where, it could be expected that, if the section in question is

improved of its line capacity, the sections connected to it in Delhi area could absorb the traffic increase arising from it, and the total line-wise service improvement would prove cost effective.

4 - 1 - 2 Later Period

The improvement plans for the Later Period are proposed, selecting the projects based on the criteria the same as above. It should be noted, however, that, the selection was made under the presupposition that these projects would become cost-effective, without being hampered by the inadequancy of the line capacity of the related sections located exterior to the 200 km radius area.

4 - 2 Line Capacity Improvement of Related Sections

The additional improvement works to be made in the Earlier Period are as shown in Table 4.2.1 below.

Table 4.2.1 Additional Improvement Plan of Related Lines/Section by 2000

Section	Existing Facilities	Improvement Plan
Ghaziabad ~ Tundla 183.8km	Double tracked, Electrified Absolute Block System	Modernizing Signalling System
Naya Azadpur~ Ambala 188.2km	Double tracked, Non-Electrified, Absolute B. System	Modernizing Signalling System
Shakurbasti ~ Rohtak 59.7km	Double tracked, Non-Electrified, Absolute B. System	Modernizing Signalling System
Rohtak~ Jakhal 129.1km	Single tracked, Absolute B. System, Non-Electrified	Track Doubling
Palwal~ Mathura 83.4km	Double tracked, Electrified Absolute B System	Modernizing Signalling System
Patel Nagar ~ Rewari 74.7km	Double (partially Single tracked), Non-Electrified Absolute B. System	Track Doubling Modernizing Signalling System

(See Fig. 5.5.1)

The improvements to be made during the Later Period are as shown in Table 4.2.2 below.

Table 4.2.2 Additional Improvement Plan of Related Lines/Section by 2010

Section		Improvement Plan
Ghaziabad ~ Khurja	32.5km	Additional track : 3 tracks
Khurja~ Tundla	121.3km	Track Quadrupling
Khurja~ Palwal~ Rewari~ Photak	210.5km	New 'Delhi Avoiding Line'
Tuglakabad~ Palwal	39.4km	Additional track : Quadrupling
Palwal~ Mathura	83.4km	Track Quadrupling
Ghaziabad ~ Hapur	37.0km	Track Doubling
Murad Nagar ~ Meerut City	29.5km	Track Doubling
Holambi Kalan ~ Ambala	177.0km	Electrification

(See Fig.5.5.1)

4 - 2 - 1 Track Addition

Earlier Period

(1) Indian Railways is now pushing on the track addition in some sections of the related lines. Among them are the quadrupling of tracks at Sahibabad-Ghaziabad which will be completed in the Spring 1990, and doubling of tracks at Garhiharsa-Khalilpur (MG) which will be completed by March 1991.

(2) Besides, according to the Team's view, considering the traffic demand, it is also important to complete the track addition between Rohtak and Jakhal (129.1km). It is envisaged in Action Plan that a part of the section totalling to 75.9km in length will be double-tracked by March 1990. But the traffic trend demands the remaining portion also to be double-tracked by the

year 1999-2000. The Team plans the track addition of the remaining portion as follows.(Fig.4.2.1)

i) Sawar Gopalpur-Kinara (34.74km)
To be double-tracked by 1999-2000 .
Approximate cost 195 million Rs.

ii) Barsola-Ghaso (18.54km)
To be double-tracked by 1999-2000.
Approximate cost 104 million Rs.

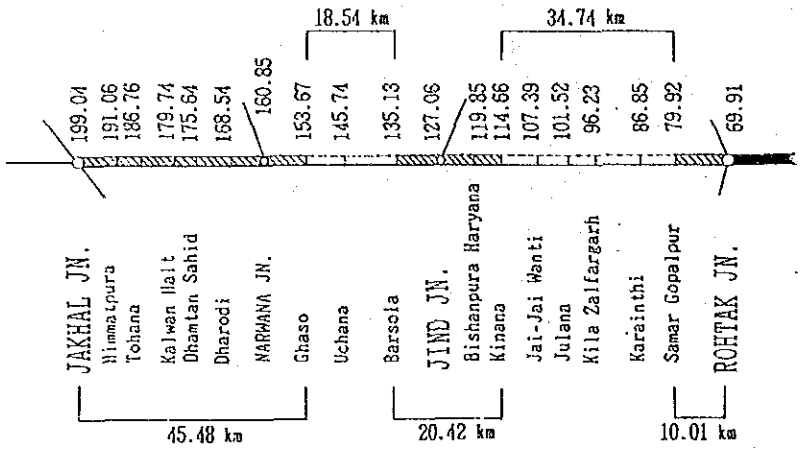


Fig. 4.2.1 Section : Jakhalk and Rohtak

Later Period

(3) Ghaziabad ～Tundla, Tuglakabad～Mathura

A by-passing route detouring the Delhi area is planned by the Indian Railways (new "Delhi Avoiding Line"). It is a new line linking Khurja and Rohtak via Palwal and Rewari. This new route is assumed to be completed in the Later Period, in order to cope with the large increase in traffic predicted for years after 2000. The section Khruja ～Palwal will be single-tracked, electrified and the section Palwal-Rewari-Rohtak will be double-tracked, electrified.

This sections Khurja～Tundla and Palwal ～Mathura connecting to this new line will have to be quadrupled. The section Khurja ～ Ghaziabad tripling and Tuglakabad ～Palwal quadrupling would be necessary, even if new "Delhi Avoiding Line" was constructed.

		Construction Cost Million Rs
a. New Delhi Avoiding Line	210.5km	3850
b. GZB-KRJ (Tripling)	32.5km	360
c. KRJ-TDL (Quadrupling)	121.3km	2340
d. TKD-PWL (Quadrupling)	39.4km	440
e. PWL-MTJ (Quadrupling)	83.4km	1610

(5) Ghaziabad ~ Hapur

In order to meet the increasing demand in the Delhi area, the suburban sections Ghaziabad ~ Hapur and Murad Nagar ~ Meerut City are to be strengthened by track addition.

		Construction Cost Million Rs
a. Ghaziabad-Hapur	37.0km	210
b. Murad Nagar-Meerut City	29.5km	170

4 - 2 - 2 Electrification

In planning the transportation improvements of the related lines/sections, for eariler period, the electrification was considered only for the Holambi Kalan goods terminal. As to the electrification up to Ambala, it is already envisaged in the Action Plan. The Team took the plan "B Route", and assumed that it would be completed at the end of the Project i.e., in 2009-10. It is because this electrification aims at developing the area further north from Ambala rather than the Delhi area. The line/sections for which the electrification was planned are as shown in Table 4.2.3.

Table 4.2.3

Section	Operating km	Cost of Electrification	Target Year
		(Million Rs)	
Delhi ~ Holambi Kalan	20.10	69	1994
Holambi Kalan ~ Ambala	177.04	530	2010

4 – 2 – 3 Modernization of Signalling System

When the construction and improvement of the terminals in the Delhi area is made, the train handling capacity of the area will be greatly increased. In order to catch up with this increase, the line capacity of the relevant sections connected directly to the Delhi area must be raised.
For this purpose a signalling modernization plan is set up for the sections which are shown in Table 4.2.3-1.

The plan consists of the following five improvement plans:

(1) Block System Improvement Plan

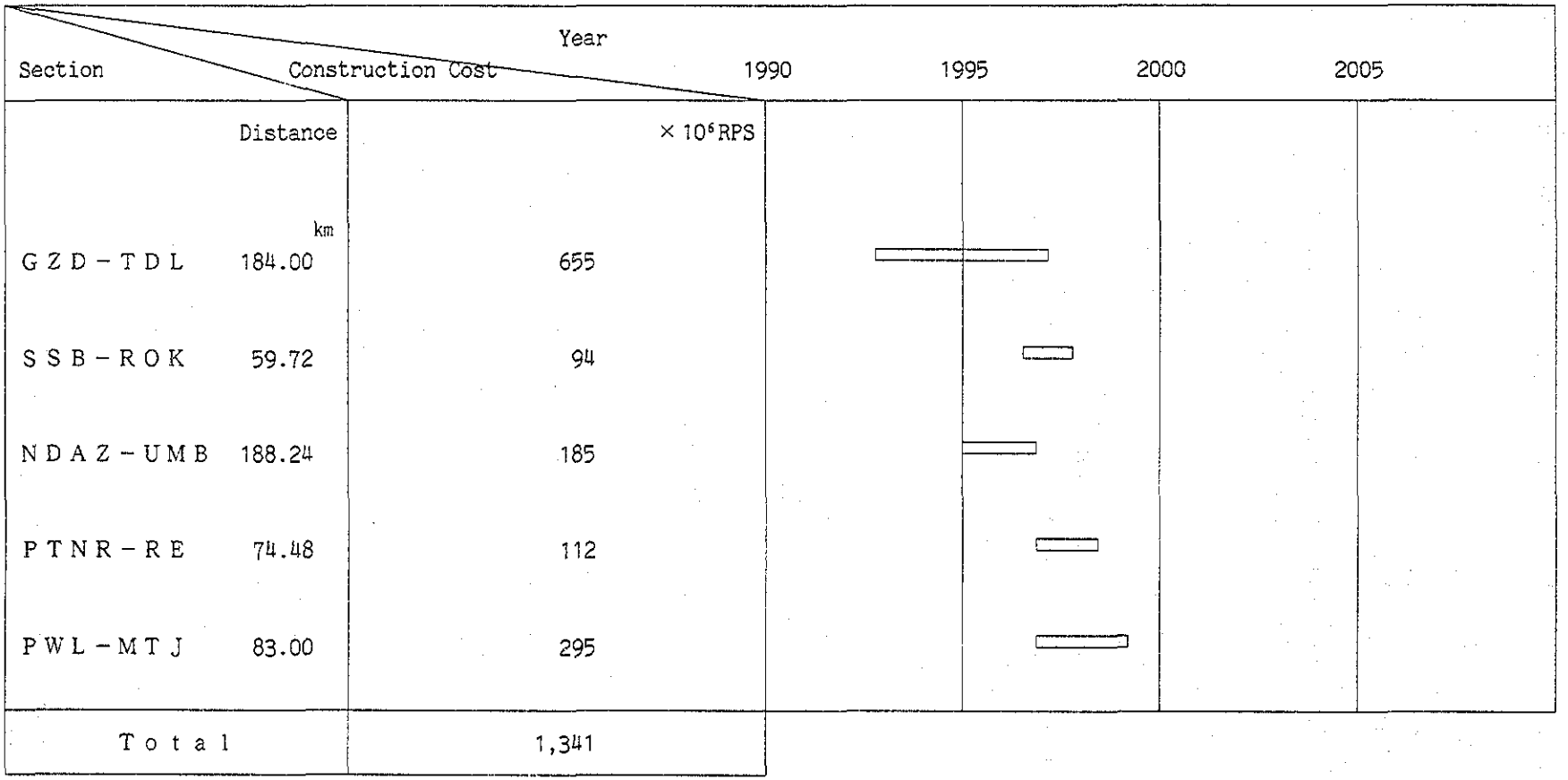
Of the sections directly connected to the Delhi area, only a part of the Tuglakabad-Mathura section is double-tracked and with automatic block system. Basically, the absolute block system is used on double-tracked sections and the tokenless or tablet system on single-tracked sections. To comply with the traffic demand forecast for 2010, the introduction of automatic block system must be expanded as shown in Fig. 4.2.3-1.(See Appendix 6-1(1)(2))

Table 4.2.3-1 Automatic Signalling Plan in the Related Sections

Target Year	Plan Section	Existing Signalling System	Distance km
① 2000	Ghaziabad-Tundla (TDL) (GZB) (TDL) 20 204	Absolute Block System Colour Light Signal DC-Track Circuit Axle Counter	184 (164)
② 2000	Shakur Basti-Rohtak (SSB) (ROK) 10 70 * MACL	Absolute Block System 2 Aspect Semaphore DC-Short-Circuit (Except SSB)	60 (52)
③ 2000	Delhi AZADPUR-Ambala Cant (NDAZ) (UMB) 9 197 **IBS between UMB and MOHRI	Absolute Block System Colour Light Signal DC-Track Circuit	188 (161)
④ 2000	Patel Nagar Rewari (PTNR) (RE) 8 82 * MACL	Absolute Block System/ Tokenless type 2 Aspect Semaphore DC-Closed/Open Circuit (Except SSB)	74 (65)
⑤ 2000	Palwal-Mathura jn. 62 145 (PWL) (MTJ)	Absolute Block System Colour Light-Signal DC-Track Circuit Axle Counter	83 (71)

* MACL Multiple Aspect Colour Light Signal
**IBS Intermediate Block System

Fig 4.2.3-1 Modernization of Block System and Construction Cost



Section	Distance	Construction Cost
	km	× 10^6RPS
G Z D − T D L	184.00	655
S S B − R O K	59.72	94
N D A Z − U M B	188.24	185
P T N R − R E	74.48	112
P W L − M T J	83.00	295
T o t a l		1,341

Note. 1. The cost includes the cost of installing relay interlocking system.

2. On sections GZB-TDL and PWL-MTJ, high-speed trains (Max.160km/h) are operable.

(2) Signalling System Improvement Plan

At present, the signals on sections with the absolute block system consist of home signals, starting signals, first distant signals, second distant signals, and last stop signals (see Appendix 6-1(3). On the other hand, in sections with mechanical signals, the signals consist of distant signals, home signals (including warners), starting signals, and last stop signals (which are installed on double-tracked sections only, with each signal having an overlapped section of 120 metres (see Appendix 6-1(4)).

It is planned in the Study that all the signals in the Delhi area be modified to four aspect-type, except at sidings where three aspect(G.Y.R.)-type will be adopted. Block signals located near railway crossings will be interlocked with the crossing gates and work in conjunction with the gate signals.

The signals of the Tundla and Mathura routes where high-speed trains (160 kph max.) are planned will be modified to a four-aspect type.

Where speed is restricted on entering a siding, a five-aspect type will be adopted (G,YY, Y, YU and R.). Fig. 4.2.3-2 shows the typical installation pattern of the signals.

Section and Station	MACL'S Signals (Existing ones)
GZB － TDL	Home. Starter. Advanced Starter. 1st Distant. 2nd Distant
SSB	Home. Starter. Advanced Starter.Distant.
NDAZ － UMB	Ditto
PTNR	Ditto

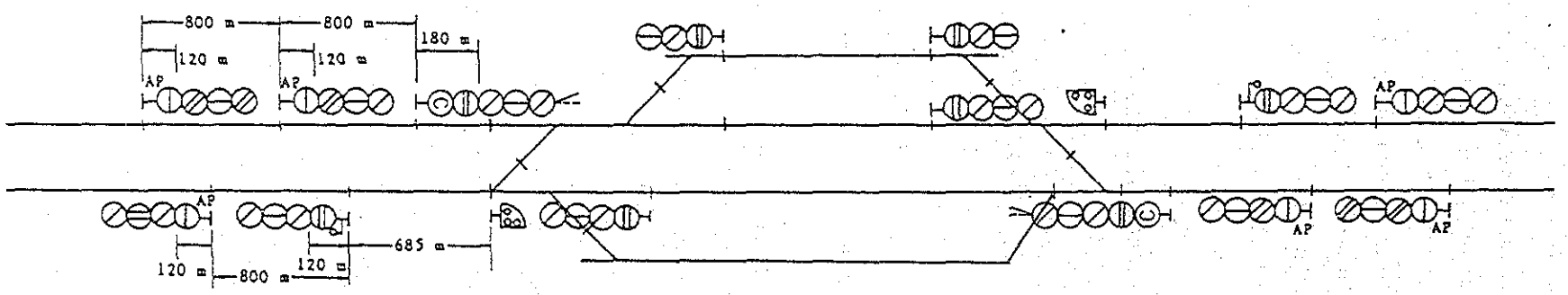


Fig.4.2.3-2 Signals on Automatic Block Sections

(3) Train Detection Improvement Plan

Train detection is conducted at present by using single-rail DC track circuits with a control length of 350 metres. These track circuits are installed between stations or within yards having PRC sleepers.

In Delhi Station, at places that are influenced by DC disturbing current, high voltage impulse track circuits are used. On sections having iron sleepers and the like, axle counters are installed at some places.

When automatic signalling system is introduced, it is necessary to secure the block sections of 600 m to 1 km in length so that said block sections will not be affected by track conditions. In this case, in order to select the most appropriate train detection system, a comparative study of the functions, electrical characteristics, and cost effectiveness must be conducted focusing on their impacts on the following issues:

- Passengers' riding comfort (whether or not long welded rail can be used)
- Possibility to introduce on-board signals
- Maintenance cost (obsolescence of insulation and impedance bonds as well as concentration of equipment.)

Note: Non-insulated AF track circuit system will be most appropriate for satisfying the above issues. But Indian national standards regarding the leakage conductance (0.5 S/km, 0.25 S/km) should be satisfied by improving the electrical insulation characteristics of PRC sleepers. It is also necessary to replace the iron sleepers with PRC sleepers and with wooden sleepers under turnouts.

(4) Relay Interlocking Improvement Plan

In Delhi area almost all the stations are relay-interlocked (RRI or panel type), except for the three stations: D. Sarai Rohilla, D. Cannt and Shakur Basti, where mechanical interlocking devices and SM'S slide frame are used and the track circuits and end panel are installed.

On sections connected directly to the Delhi area, about one half of the station yards are relay-interlocked (RRI type at 17 stations and panel type at 50 stations). The rest (62 stations) are still mechanical (see Appendix 6-1(5)).

The mechanical interlocking system stands in the way of improving the line capacity. Its lever handling and required communications between signal cabins take much time.

To realize the high-speed operation (160 km/h max.), switching and locking equipment must be strengthened and turnouts replaced by elastic points. The present mechanical interlocking equipment must be replaced.

In recent years, the functionally superior electronic interlocking equipments have been introduced in advanced railways. Considering the rapid development of electro-mechanical technology, the replacement must be made either by the conventional RRI or by the electronic interlocking equipments. (See Appendix 6-3)

(5) Railway Crossing Improvement Plan

There are 349 railway crossings at level in Delhi area and the related sections. This means a train crosses the road at every 2 or 3km of operation. (See Appendix 6-1(6)(7)) They are all manned, equipped with a telephone to communicate with adjacent stations, and those crossings with heavy traffic roads are interlocked with gate signals. Some of them are equipped with train approach warning bells.

It takes 5 - 6 minutes for a gateman to finish lowering down the

gates/barriers and indicate the proceed signal, since having been informed of a train approach by telephone. Therefore, the gate closing time will increase in proportion to the number of trains. This brings about a serious disturbance to the road traffic.

A new control system is proposed, to reduce the hindrance to road traffic to the minimum. In the current gate signal system, the approach of a train is informed to the gateman at a timing with sufficient safety allowance, regardless of the train speed. In the new system, the speed of a train approaching the crossing, is detected and the alarm timing is controlled so that the time from alarming till the train's arrival at the crossing, would be kept constant. (Refer to Appendix 6-6)

4 - 3 Line Capacity Improvement of Sections within Delhi Area

Earlier Period

The transportation plan proposed in 3-2-2 presupposes the improvement in traffic capacity of some bottleneck sections within Delhi area. They are as shown in Table 4.3.1. In planning them, however, effectiveness was one of the key criteria. Namely, even if these sections within the Delhi area are improved, it will not become effective if the sections in the outer circle are not improved. Therefore the improvement within the area is justified only when the improvement of the exterior area is supported by a higher investment priority. Otherwise the improvements within the area would not prove effective.

Later Period

The amount of the investment required to increase the line capacity of the sections in Delhi area would be tremendous, if the same traffic pattern is to be observed in coping with the increasing traffic demand in this area after 2000.

It is therefore necessary to by-pass the goods traffic by way of the new line (New Delhi Avoiding Line) to ease the line capacity within the area. It is also necessary to build some satelite terminals in the periphery of Delhi area to ease the traffic pressure, which will be referred to in the next chapter.

Hereunder are given the principal line capacity improvement plans required within Delhi area.

Table 4.3.1 Improvement Plan of the Bottleneck Section within Delhi Area

Section, Places	Planned Improvement
Entry to NDLS from direction Tilak Bridge	Modify the track layout from 3 track routes to 4 track routes to enable using platforms at the same time with New Delhi Station improvement
Rampura Cabin (D.A.L.)	Eliminate surface crossing of D.A.L. with Main Line.
Rampura Cabin ~ Naya Azadpur	Double the track, as well as electrify the section.
New Delhi/Delhi ~ Subzi Mandi/D.Kishanganj	Eliminate the surface crossing of MG and BG tracks.
Tilak Bridge~ Shahibabad	Quadrupling the track, and construct a grade separation at "B" Panel.
Tuglakabad~ Lajpat Nagar ~Nizamuddin	Improve Turnouts
Section of Absolute Block System	Improve to Automatic Block System

(See Fig.5.5.2)

4 - 3 - 1 Elimination of Surface Crossing at Rampura Cabin

Surface crossing of tracks at Rampura Cabin is considered as one of the most serious bottlenecks of the train operation in Delhi area. In terms of the seriousness it is surpassed only by the surface crossing of MG and BG tracks west of Delhi Station.

(1) Track interference ratio

112 trains cross each other at Rampura Cabin.

Table 4.3.2 tells the situation. The track interference ratio is estimated at 45% at present. If two hours of maintenance are to be secured, it will rise to 49%. The ratios are almost critical. In the year 2000, the ratio will exceed 65% with the increase of trains. It will be worsened by the addtional goods trains which will be operated in this section in order to transfer the goods handling from New Delhi to Holambi Kalan.

The grade-separation of tracks at Rampura Cabin should be realized as early as possile. Doubling of tracks between Rampura and Naya Azadpur and the electrification of the section between Patel Nagar and Holombi Kalan should also be conducted in the same occasion.

(2) Concept of grade-separation

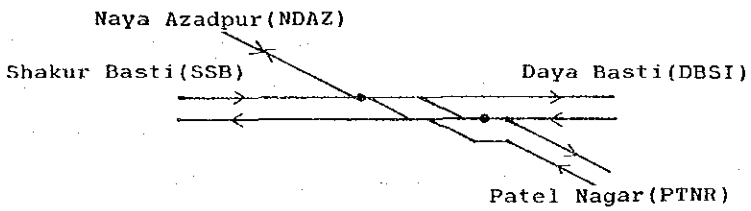
The improved Delhi Avoiding Line, leaving Patel Nagar, will pass under the overbridge at New Rohtak Road. The line will be double-tracked. It will ascend with the gradient of 5/1000, and cross the Main Line at a point nearer to Shakur Basti than at present. Then it will descend with the gradient of 5/1000, and meets the existing line before it crosses the Western Yamuna Canal.

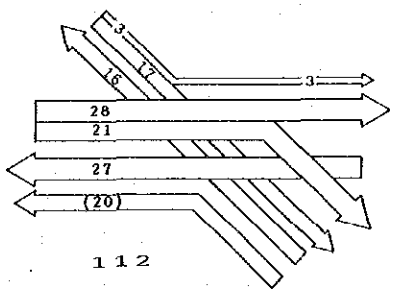
The track will be of an embankment structure in general, but it will be made of an elevated concrete structure when the rail head gets higher than five metres from the ground level. This is chiefly for protecting landscape and keeping the structure airy.

Table 4.3.2 Number of Trains Crossing at Rampura Cabin

Nov.1,1988

Route	Passenger Train			Goods	Light Eng.	Total
	Mail /Exp.	Local	Total			
SSB → PTNR	–	–	–	10	11	21
PTNR → SSB	–	–	–	(9)	(11)	(20)
SSB → DBSI	5	11	16	1	11	28
DBSI → SSB	5	11	16	–	11	27
NDAZ → DBSI	–	–	–	3	–	3
DBSI → NDAZ	–	–	–	–	–	–
NDAZ → PTNR	–	–	–	15	2	17
PTNR → NDAZ	–	–	–	14	2	16
Total	10	22	32	(9) 43	(11) 37	(20) 112





At the grade-separtion, the steel bridge structure will be adopted. The conceptual route will be as shown in Fig.4.3.1. It is to be completed by 1994-95.

An approximate cost of construction will be 116 million Rs.

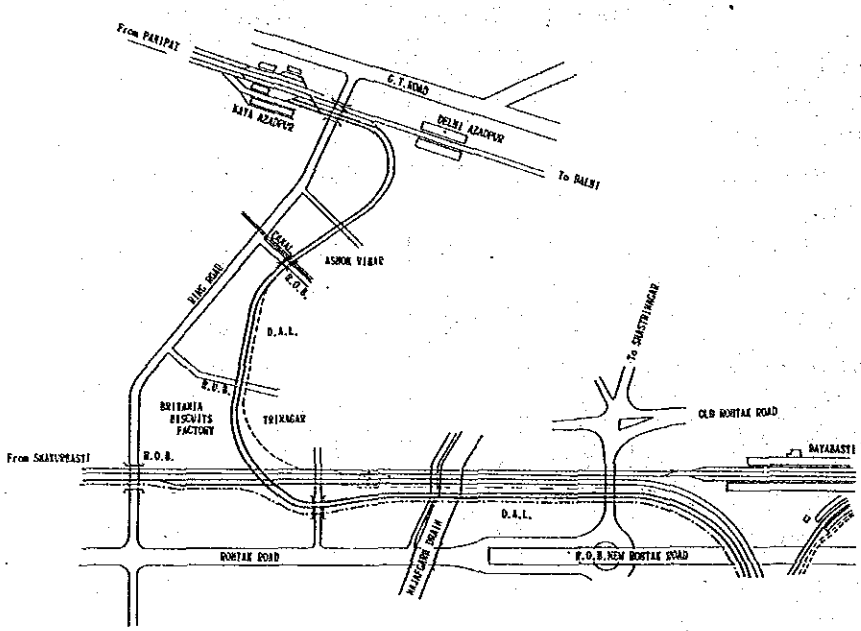


Fig.4.3.1 Conceptual Route - Rampura Improvement

(3) Relationship with the new "Delhi Avoiding Line"

Rampura Cabin work may become unnecessary when the new "Delhi Avoiding Line is completed. But the construction of the latter will be no earlier than 2000. The total avoidable losses arising from the restriction in train operation at Rampura Cabin would certainly surpass the cost of eliminating the surface crossing suspended until 2000. The elemination should be expedited.

(4) Other related works

The detour B Moradabad - Ambala (Goods) was out of the scope of work in this Study. When it is executed, however, the Rampura Cabin works should be well coordinated with it.

4 - 3 - 2 Improvement of the Section: Anand Vihar-Tilak Bridge/Nizamuddin

The surface crossing of tracks at Tilak Bridge where the Goods Avoiding Line bifurcates from the line leading to Nizamuddin, is also considered to become a bottleneck in the train operation of the area.

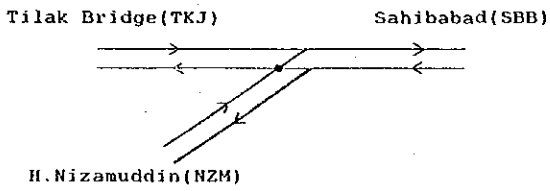
(1) Track interference ratio

86 trains cross each other at this point. The interference raito is now 31%. It will not cause a serious trouble at present, but the ratio will exceed 45% in the year 1999-2000, with the expected increase of trains (Table 4.3.3).

Tabel 4.3.3 Number of Trains Crossing at Tilak Bridge

NOV.1,1988

Route	Passenger Train			Goods	Light Eng.	Total
	Mail /Exp.	Local	Total			
NZM → SBB	-	-	-	30	15	45
SBB → TKJ	16	7	23	3	15	41
Total	16	7	23	33	30	86



(2) Concept of improvement

Goods trains will be operated on a new line which will dispense with surface-crossing. The new line will be double-tracked and constructed between Sahibabad and a point a short way to the north of Nizamuddin considering the possible requirements (avoiding the surface crossing of goods trains and passenger trains leading/leaving Anand Vihar)arising from the construction of a new passenger terminal at Anand Vihar. "B" Panel will also be grade-separated. A conceptual route will be shown in Fig.4.3.2.

It is to be completed by 1998. An approximate cost of construction will be 330 million Rs.

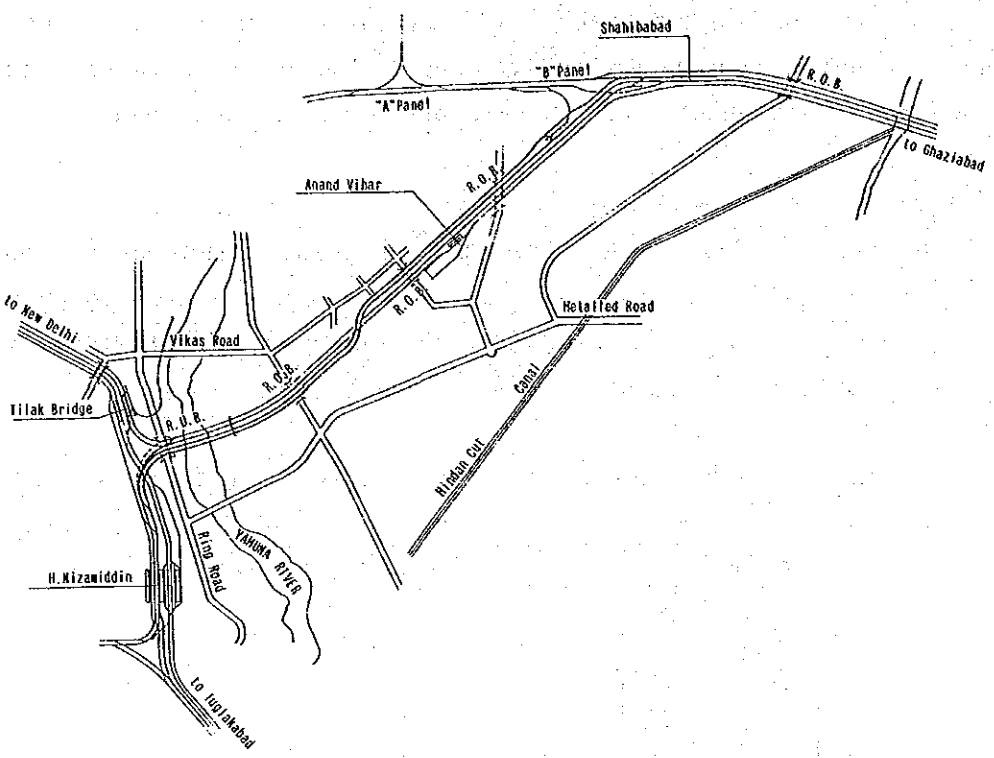


Fig.4.3.2 Conceptual Route-B Panel Improvement

4 - 3 - 3 Modernization of Signalling in Delhi Area

In Delhi area, generally speaking, the Signalling system is double line automatic block system or twin single line automatic block system. But the sections where the distance between the stations is short and where there are surface crossings, they are equipped with absolute block system with continuous track circuits. The same with the MG sections. The signals on the automatic block section consist of home, starter and last stop signals. Signal indication is made in 3 aspects type (G, Y and R) for the home and starter and 4 aspects type (G, YY, Y and R) for the block. For the absolute block section, signal indication is made in 3 aspects of G, Y and R.

A gate signal interlocked with crossing barriers is installed at a point 180 m before the railway crossing in an average. The block length is 600 to 800 m on the automatic signalling section. As for Good avoiding line (GAL), the block length is twice longer than that of other lines. The sections planned to install the Automatic Signalling in Delhi area are shown in Table 4.3.3-1. Their construction schedule and cost are indicated in Fig.4.3.3-1.

The present number of block assignment and the signal indication will be modified as follows.

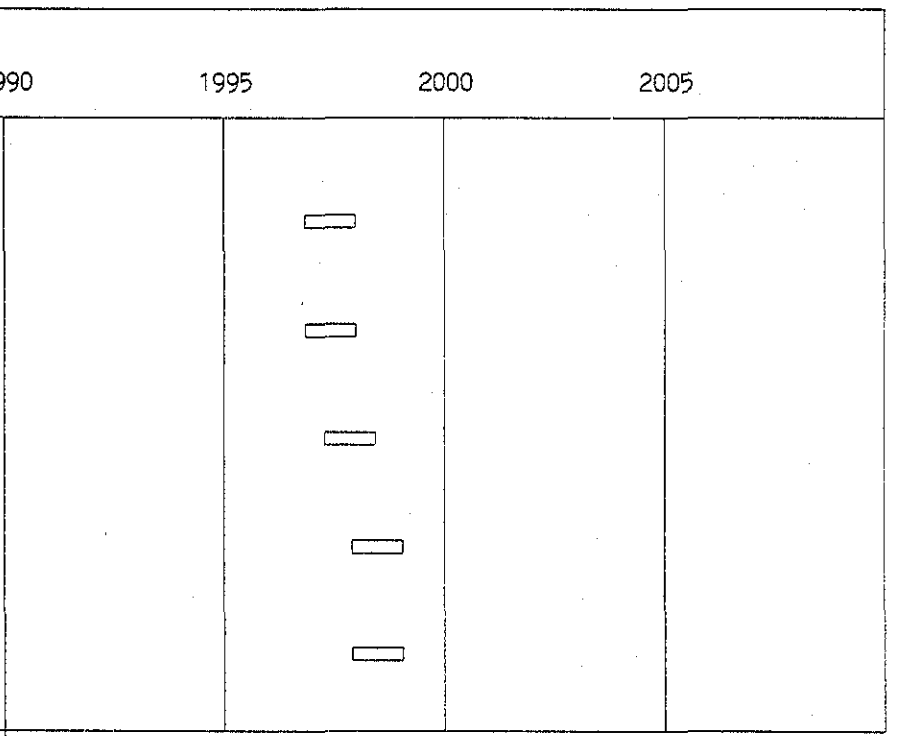
	Signal Indication	Block Length
Present	3 aspects	1500 - 1600m
Improvement	4 aspects	600 - 800m

Table 4.3.3-1 Automatic Signalling Construction Plan in Delhi Area

Target Year	Section	Signalling System	Distance Km	Number of Station including Both Side Stations
1999-2000 Phase ①	DLI-SSB	Absolute Block System	10.19 (7.19)	4
Phase ②	DLI-NDAZ	Colour Light (3-4 Aspect Signal Indication)	8.90 (6.90)	3
Phase ③	DLI-NDLS	DC Track Circuit	4 (3)	2
Phase ④	NZM-TKD	MACL with Continuous Track Circuits	10 (8×2)	3
Phase ⑤	LPNR-TKD	Ditto	10 (9)	3

Fig. 4.3.3-1 Automatic Signalling Construction Schedule and Cost

	Section	Distance	Construction Cost
		km	× 10^6RPS
Delhi Area	DLI－SSB	10.19	6.7
	DLI－NDAZ	8.90	6.4
	DLI－NDLS	4	2.8
	NZM－TKD	10× 2	14.8
	LPNR－TKD	10	8.4
Total			39.1



CHAPTER 5 FUNCTION ASSIGNMENT TO TERMINALS IN DELHI AREA

CHAPTER 5 FUNCTION ASSIGNMENT TO TERMINALS IN DELHI AREA

5 - 0 Aims

(1) The traffic requirements in the outer circle of 200 km radius and its impact to the inner cirle (Delhi area) has been identified. Contrasting with them, the train operability in the both circles has been clarified from the viewpoints of line capacity as well as terminal capacity of Delhi/New Delhi (Chapter 3). To fill the gap between the requirements and the train operability, the Indian Railway's plans have been reviewed and some additional counter-measures have been proposed (Chapter 4). A new picture of traffic demand and supply is thus prepared. Now the picture must be studded with the terminals renewed of its roles. This is the aim of this chapter.

(2) A main passenger terminal of a city would lose its raison d'etre, if it is located remote from the city centre. It would not be so, however, in case of auxiliary passenger terminals or goods terminals. They can play their roles at locations remote from the city center, if and when fast and frequent transportation can be provided from their locations to the city center. The renewal of the roles of the terminals in Delhi area often means, therefore, moving these complimentary passenger terminal functions and the goods terminal functions from the city center to the periphery.

(3) When this dispersal of terminal functions from the city center can be justified in the light of the new picture of traffic demand and supply structure, the "Master Plan" finishes its part.

(4) This chapter studies the possibility of dispersing some part of the New Delhi Station's train handling functions to remoter places, dividing the functions into four categories: Namely, handling of 1) MG passenger trains, 2) MG goods trains, 3) BG goods trains and 4) BG passenger trains.

5 - 1 New Location of MG Passenger Terminals

Delhi Station has facilities to deal with the MG passenger trains. And the MG tracks cross with BG tracks at two places west of Delhi Station, causing a serious bottleneck for the train operation of the area. The situation will be worsened in future not only in terms of efficiency but also in terms of safety, as the number of trains will increase. Moving Delhi's MG passenger handling function to the suburbs is a must. Three solutions are considered.

Case 1: Relocate Delhi MG passenger function to Bijwasan where a new MG passenger terminal will be built.

Case 2: MG-BG Tracks will be grade-separated and Delhi Main will be reconstructed to a two floored building (given another elevated or underground floor) and its MG passenger facilities will be moved to this new floor.

Case 3: Modify Patel Nagar Station on the Ring Line into an MG passenger terminal and move Delhi's MG passenger functions to it.

5 - 1 - 1 Case 1 : Bijwasan

In Case 1, the number of trains expected to be handled at the new Bijwasan terminal will be as shown in Table 5-1-1. The estimation is based on the transportation plan described in paragraph 3-3-2-12.

Table 5.1.1 Number of MG Passenger Trains treated at Bijwasan

Class	Oct.1988	1994-95	1999-00	2009-10
Exp./ Mail	11	11	16	27
Local	9	10	11	17
Total	20	21	27	44

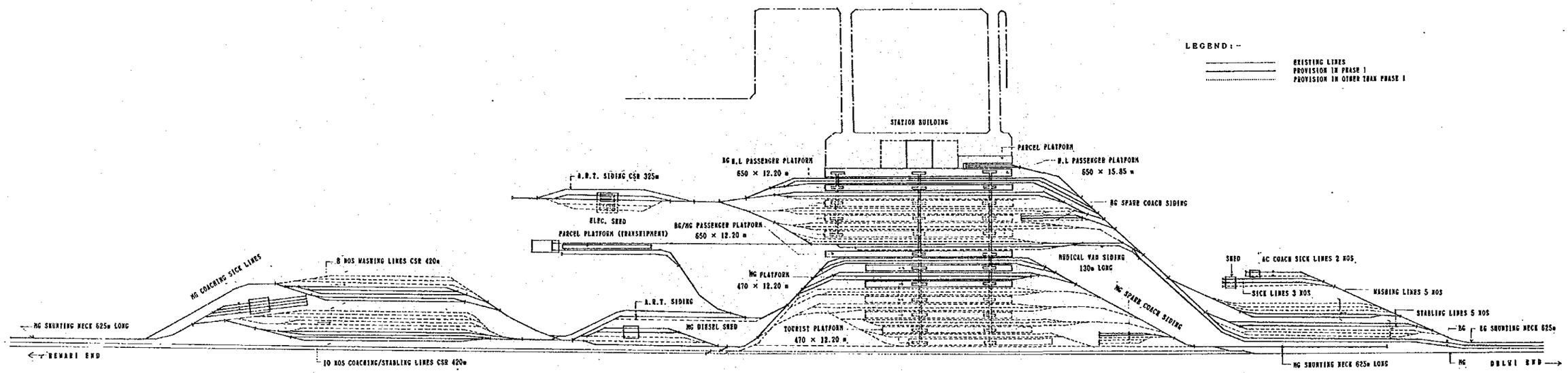


Fig.5.1.1 Bijwasan Passenger Terminal

Note: · Number of trains shows departure trains in Oct. 1988.
· "Total" covers the number of trains at Delhi, Sadar Bazar and Sarai Rohilla.

In order to transfer the MG passenger functions from Delhi to Bijwasan, the following improvement in service and in facilities will become necessary.

(a) The new Bijwasan MG terminal must be installed with the BG passenger facilities which enable the passengers to transfer from MG trains to BG trains at Bijwasan.

(b) A new BG line(double-tracked) must be constructed between Bijwasan and Kirti Nagar, which enables a frequent shuttle service connecting to Delhi/New Delhi e.g. by EMU trains whose operation schedule is adapted to MG's.

(c) The new line should be electrified, if the frequent shuttle service is provided by EMU trains.

A conceptual layout of Bijwasan passenger terminal is shown in Fig. 5.1.1 and an approximate cost of construction is given below

MG facilities	133 million Rs
BG facilities	112 million Rs
BG Line (includes electrification)	101 million Rs
Total	346 million Rs

5 - 1 - 2 Case 2 : Grade-separation

The MG elevated track or MG underground track will be required in this case. In the latter, the underground, the construction cost will be too expensive, because the foundation of the involved over-bridge must be protected and the work site requires a large space. The track elevation is more practical. The construction work will need the following considerations:

(1) The elevation will be 14 to 15 meters high, as the MG track must pass over the road bridge which, itself, crosses over the BG

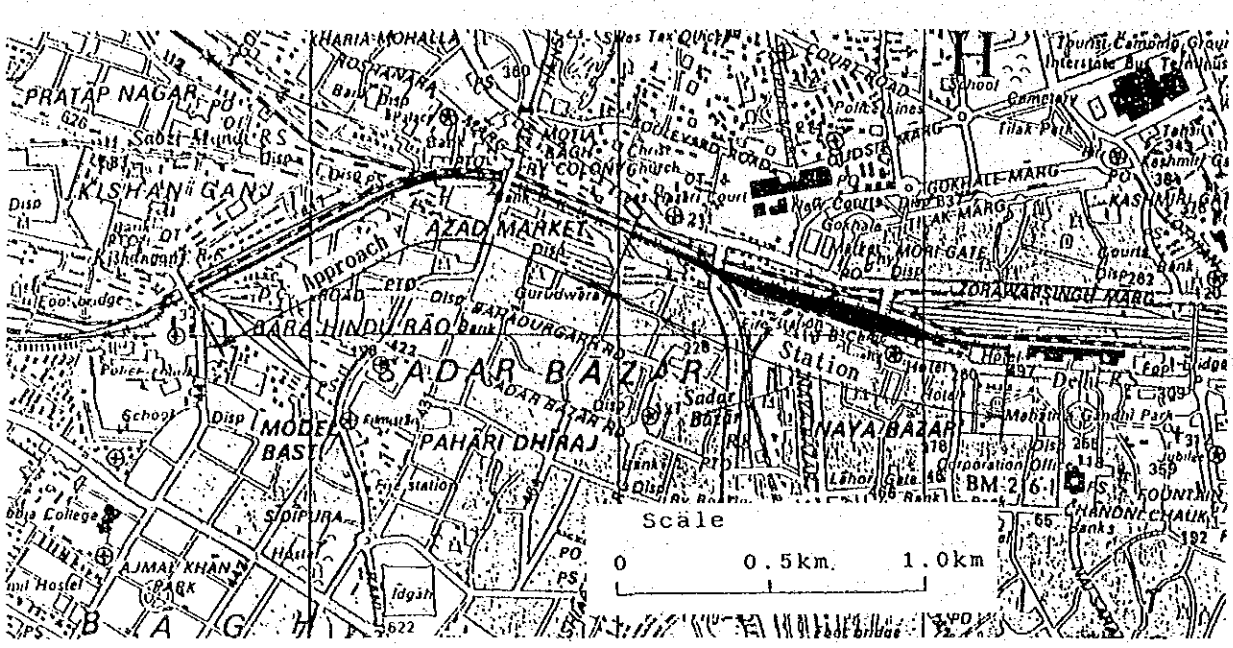
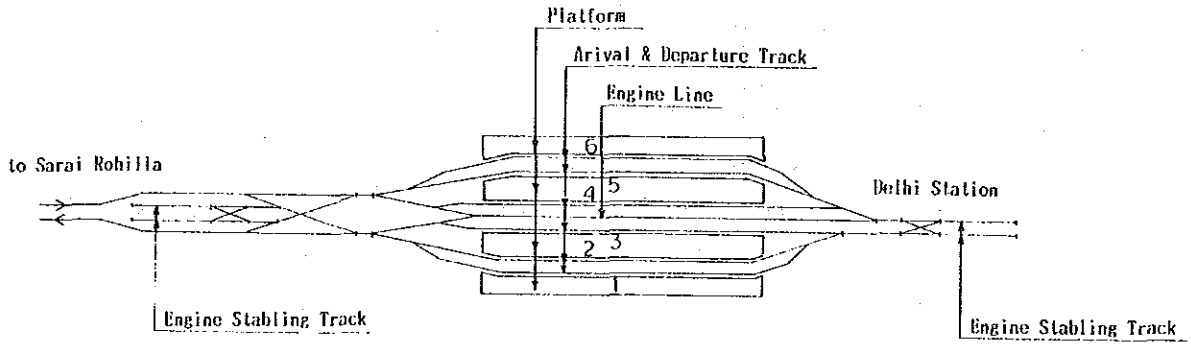


Fig.5.1.2 Location of the Elevated MG Station



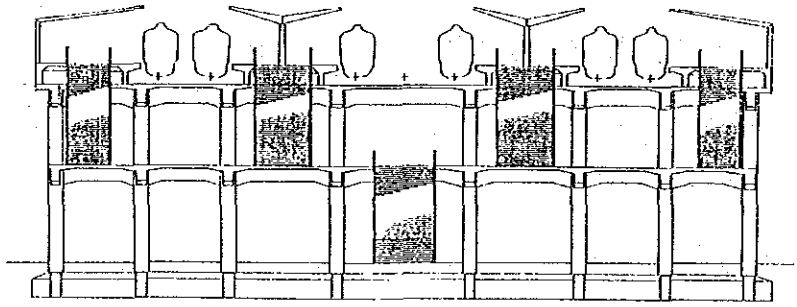


Fig.5.1.3 Conceptual Plan of the Elevated MG Station

tracks. The length of the elevated section will be about 2 km to approach the elevated Delhi station. (See Fig. 5.1.2)

(2) The washing lines, stabling lines for the MG trains will be constructed on the ground level (not on the elevated level, as it costs too expensive). The space will be available at Sarai Rohilla where the goods facilities are removed and shifted to Bijwasan. When Sarai Rohilla is not available, the space must be looked for at a remoter place.

(3) The track layout of Delhi Station will be as shown in Fig. 5.1.3, considering the future increase of trains.

An approximate cost of the construction will be as follows:

Elevated station and approach track	372 million Rs
Maintenance facilities at Sarai Rohilla	47 million Rs
Total	419 million Rs

5 - 1 - 3 Case-3 : Patel Nagar

Patel Nagar Station on the Ring Line will be totally reconstructed as an MG terminal. (Fig. 5.1.4)
The required construction works and the measures to be taken are:

(1) Build, at Patel Nagar, five platforms for MG trains and two platforms for BG trains. Add engine line, locomotive waiting line and stabling lines.
(2) Build, at Sarai Rohilla, the washing lines and stabling lines for the MG trains of Patel Nagar. As there is little space for them in Patel Nagar, they have to be built in Sarai Rohilla where the exsiting goods facilities will be moved to Bijwasan.
(3) Extend a single-tracked BG line from D. Cant to Bijwasan to get the BG trains to reach it for transshipment.
(4) At the western side of the Patel Nagar, a space should be secured

for building a front plaza and access road. Part of the existing railway office buildings and the now non-functioning factory will have to be removed.

(5) Run additional EMU trains on Ring Line to provide the MG passengers with access to New Delhi/Delhi from Patel Nagar, as is programmed in the Action Plan.

(6) Remove the existing MG track between Sarai Rohilla and Delhi. The remaining portion of the track (Sarai Rohilla — Patel Nagar) will be utilized to provide a passage for the MG trains of Patel Nagar to reach Sarai Rohilla for washing and stabling.

An approximate construction cost is as given below.

Patel Nagar terminal	117 million Rs
Maintenance facilities at Sarai Rohilla	57 million Rs
Total	174 million Rs

5 - 1 - 4 Evaluation

The merits and demerits of the three cases described above are compared in Table 5.1.2.

(1) Case 2 may offer an high level of convenience to the MG passengers but the investment cost will reach a tremendous amount and the construction work is complicated and difficult. Case 2 cannot be considered as a feasible alternative. Therefore Cases 1 and 3 are compared.

(2) The roles MG Line service plays in Delhi area are, for one, to provide long distance passenger trains, and for another, to provide Delhi area dwellers the commuter service to and from the city center. From this viewpoint an MG terminal in Delhi area should be;

1) located as near as possible to the business centers of the city.
2) providing good transportation access to the business centers of the city.

3) providing good transportation access to the stations where the long distance services bound for other places are offered, i.e., New Delhi/Delhi Main.

Patel Nagar is better located than Bijwasan in view of 1) above, and in view of 2) too, as Patel Nagar is on Ring Line, the provision of EMU service will be much easier than in Case 1. Moreover, Patel Nagar is near to Patel Road where an LRT Project is being considered. If it is realized, it would be connected to the station. Patel Nagar will become one of the best served points in the Delhi's urban railway network.

Furthermore, the addtional EMU services should not be considered as a convenience specialized for MG passengers. They would also serve the train users at large in the whole Delhi area.

For the above reasons, Case 2 - Patel Nagar, is recommended.

(3) The space is not large enough at Patel Nagar to construct the newly required washing and stabling facilities. They should be built at Sarai Rohilla where its goods handling facilities will have been moved to Bijwasan.

A suggestion was made during the investigation, to assign Sarai Rohilla as an MG passenger terminal which will handle some of the priority expresses, utilizing its existing MG passenger facilities. The reason is the better access Sarai Rohilla has to the city centre than Bijwasan has. The suggestion was not accepted, however, because securing the space for the station front plaza and access roads will be even more difficult here than at Patel Nagar. It would also complicate the train operation system to handle some trains at Bijwasan and others at Sarai Rohilla. To add, this suggestion does not remove the passengers of the inconvenience of making a transfer, and in the respect it is no better than Patel Nagar.

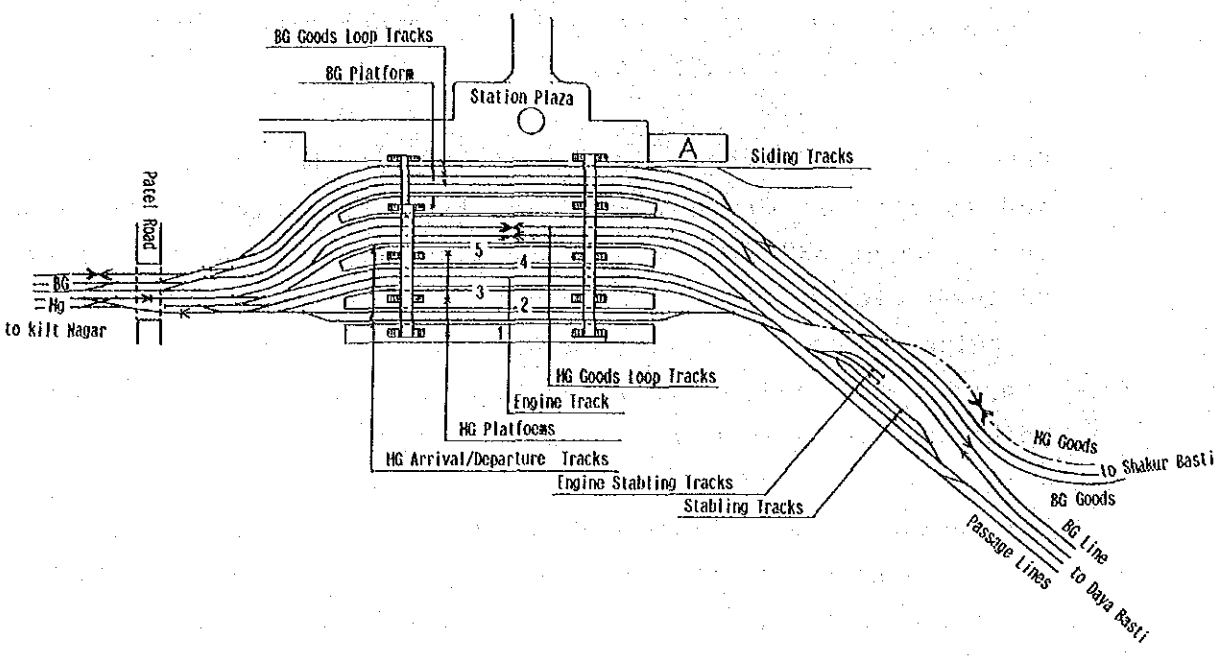


Fig.5.1.4 Conceptual Plan of Patel Nagar Terminal Track Layout

Table 5.1.2 Comparison of Alternatives for MG Terminal

Items		Case 1 Bijwasan	Case 2 MG-BG Grade Separation	Case 3 Petel Nagar
Construction Cost (Million Rs)		346	419 (excluding goods facilities)	174 (excluding goods facilities)
Merits and Demerits	Convenience for Passengers	X Changing train at Bijwasan is needed X Access transport to Delhi/ New Delhi e.g. by EMU is necessary	O Same as at present	X Changing train at Patel Nagar is needed - Access transport to Delhi/ New Delhi e.g. by increasing EMU service on Ring Line is necessary
	Terminal space	O Entire facilities can be constructed	X Maintenance facilities cannot be constructed because of the elevated track	X Maintenace facilities cannot be constructed because of space restriction
	New transportation system	- Access transport to the airport is being considered		O New urban transport e.g,LRT is being planned near Patel Nagar
	Others	O Sarai Rohilla space can be used as maintenance facilities for Delhi/New Delhi X A new BG line must be constructed between Bijwasan and D.Cant O Existing MG line between Patel Nagar and Delhi can be changed to BG	X Maintenance facilities for MG trains must be secured at Sarai Rohilla X Sarai Rohilla goods facilities must be shifted to Bijwasan X Extending BG line from D.Cant to Bijwasan is needed	X Maintenance facilities for MG trains must be secured at Sarai Rohilla X Sarai Rohilla goods facilities must be shifted to Bijwasan X Extending BG line from D.Cant to Bijwasan is needed
Evaluation		No 2	No 3	No 1

5 - 2 MG Goods

Meter Gauge goods trains reaching/leaving Delhi area are dealt with at three stations: D.Lahori Gate, Sarai Rohilla and Shakur Basti.

5 - 2 - 1 Lahori Gate

Among them, MG goods handling at D.Lahori Gate had better be abolished, The general reasons are:

(1) It is the world's trends that small goods stations are jointed together to form a larger terminal where the goods handling jobs will be mechanized.
(2) It will not be a wise decision to keep resisting these trends. More so because the railway goods handling can be shifted to suburbs, if appropriate substitute measures could be secured.
(3) D.Lahori Gate cannot be considered as an efficient goods terminal, because its access/egress is getting harder due to the congestion of the roads reaching it, will be worsened even more seriously year after year.
(4) New Delhi Station is in need of more space. Its passenger train operation back-up facilities (e.g. stabling lines) should be additionally built in a near-by place. Lahori Gate is the place, if removed of its goods handling facilities.

5 - 2 - 2 Shakur Basti

Most of the goods at Shakur Basti is dealt with by sidings. Jointing together smaller stations'goods handling to a larger terminal is essential for the modernization. But when, at some stations, the main part of loading/unloading is made by sidings, jointing such stations to a larger one could be postponed to the second step of the modernization. It should be evaluated according to the volume of the shipment. Siding owners are the railway's fixed customers and the shipment by sidings is in itself a form of "door-to-door" service.

According to the Team's view, the goods handling at Shakur Basti can be kept as it is for the time being.

5 - 2 - 3 Sarai Rohilla

As to Sarai Rohilla, two cases should be evaluated:

Case 1 : Goods handling at Sarai Rohilla is kept as it is
Case 2 : It is moved to Bijwasan

(1) Case 1 : Sarai Rohilla (Goods) remains
This case should be evaluated in respect of its impact to the option of MG passenger terminal alternatives. In Case 1, the MG passenger terminal could be located neither at Delhi nor at Patel Nagar. There will be no other alternatives than to locate it at Bijwasan. The reasons are as follows:
If Sarai Rohilla (Goods) remains, on the other hand, the passenger train operation back-up facilities for Patel Nagar cannot be built here. Therefore the Alternative Patel Nagar (5.1.3) becomes impossible.
If Sarai Rohilla (Goods) remains as it is, the MG track leading to Delhi cannot be elevated. Therefore the Alternative Delhi (5.1.2) becomes impossible.

(2) Case 2 : Sarai Rohilla (Goods) moved to Bijwasan
If Sarai Rohilla (Goods) is to be moved to somewhere else, the place cannot be other than to Bijwasan.
In this case, the required construction works and the measure to be taken are :

— Construct at Bijwasan the facilities for loading/unloading MG goods and for transshipping MG-BG. Build also a relevant diesel loco-shed.
— Extend a single-tracked BG line from D.Cant to Bijwasan.

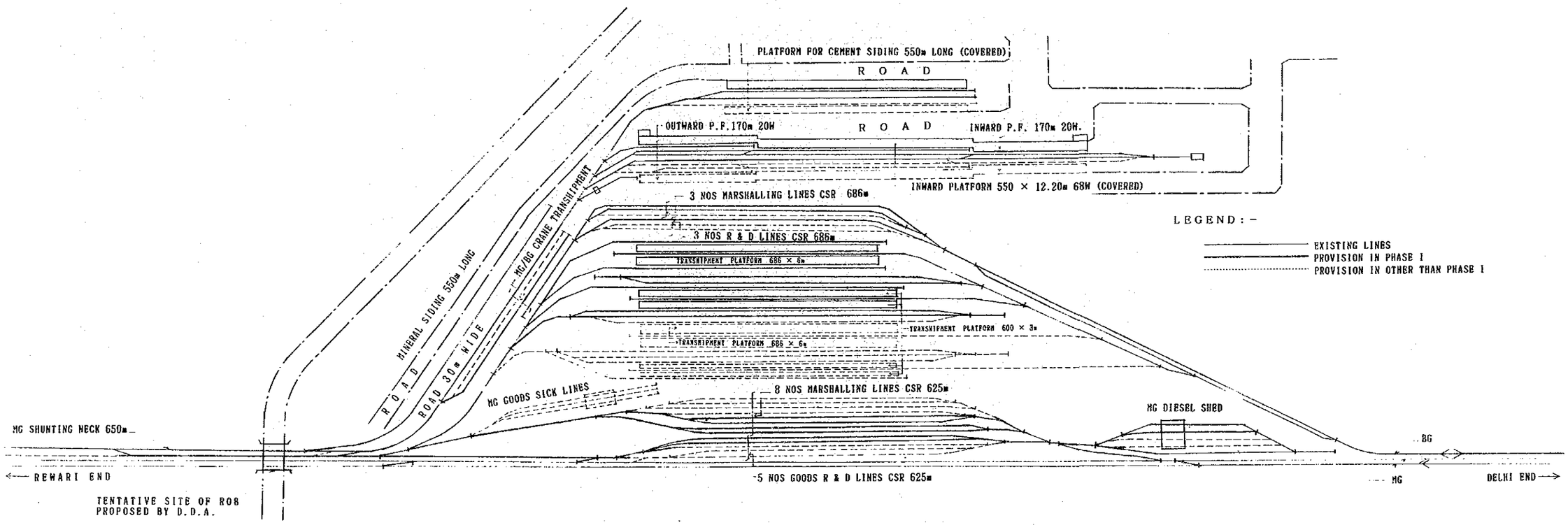


Fig.5.2.1 Bijwasan MG Goods Terminal

An approximate construction cost is as shown below.

Bijwasan MG terminal (including transshipsment facilities and extention of BG line)

construction cost ..... 280 million Rs

(Fig.5.2.1 Bijwasan MG Goods Terminal)

5 - 2 - 4 Evaluation

Case 1 requires the least investment, but for the same general reasons as given in 5-2-1 (1)~ (3) above, the Team considers that Case 2 should be recommended.

5 - 3 BG Goods

For the same reasons as justifying the abolition of the MG goods handling at D.Lahori Gate, namely, the world's trends observed in relocating the railway goods handling from the city center to the suburbs, and the worsening trends in congestion of the roads reaching the terminal, the Team considers that the BG goods handling at New Delhi (Goods) should also be relocated to somewhere else. As to the place to which it could be moved, two cases are considered:

— Case 1: D.Kishanganj, Naya Azadpur or other existing near-by goods terminal in Delhi area.

— Case 2: Holambi Kalan to be newly constructed.

5 - 3 - 1 Case 1: Shifted to near-by Goods Terminals

Merits and demerits of the Case 1 can be summarized as follows:

Merits: No investment is required, as all these terminals have sufficient allownance in capacity to deal with the goods to be shifted from New Delhi.

The reassignment/relocation of the station staff of to-be-abolished New Delhi (Goods) would cause less problems in this case than in case 2, since these goods terminals are located nearer to New Delhi (Goods).

Demerits: Sooner or later, the access/egress of these goods terminals will also become difficult, because of the worsening congestion in the roads reaching them. Ultimately the Railway might be obliged to close these terminals if the urbanization of the relevant areas so requires, and to move their functions to a suburban terminal. In this case, the shippers might be obliged to change their transport method twice in a period considered to be not so long. The goods loading/unloading work will have to be mechanized shortly. None of these existing terminals, however, have enough room in space for introducing the mechanized loading/unloading system. (fork-lift manoeuvering etc.)

5 - 3 - 2 Case 2: Holambi Kalan

In case 2, the merits and demerits of Case 1 are reversed. The description given under the merits for Case 1 can be the description of the demerits of Case 2, Conversely, the description given as the demerits of Case 1 can be that of the merits of Case 2.
Approximate cost ……… 258 million Rs.
(Fig.5.3.1 Holambi Kalan BG Goods Terminal)

5 - 3 - 3 Evaluation

It is a matter of policy rather than the matter of technical comparison, whether or not either of the two cases be selected. The Team recommends for Case 2 — moving New Delhi BG Goods to Holambi Kalan, because it would encourage the modernization of railway goods handling. Another reason supports Case 2: It is the recent development of the industrial lots quite near to the existing Holambi Kalan station.
Provided that the railway offers good service to the shippers, this would justify the relocation of New Delhi (Goods) to Holambi Kalan to a considerable degree.

Holambi Kalan (Goods) is planned, however, to be completed no earlier

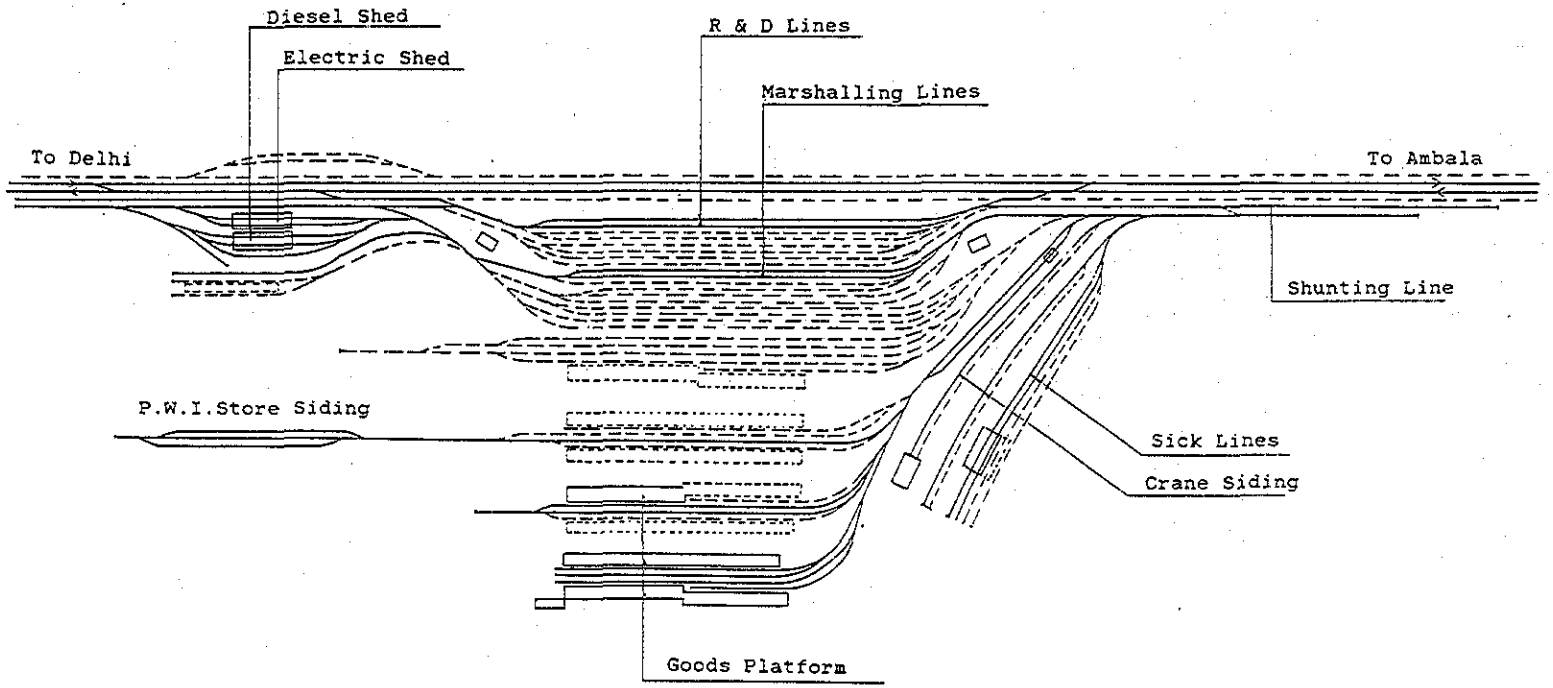


Fig.5.3.1 Holambi Kalan BG Goods Terminal

than 1995. While it is needed earlier than 1995 to remove goods facilities at New Delhi. It should be planned to shift them temporarily to the near-by goods stations (such as D. Kishanganj etc.), before they could be ultimately moved to Holambi Kalan.

5 – 4 BG Passengers

In the preceding paragraphs, the functions of the existing terminals have been proposed to be modified. Some new terminals have been proposed to be built, others to be abolished. All the reassignments of their roles have been made to achieve one thing – to deal with more BG Passengers in Delhi area.
Next issue is to best allocate the BG passenger trains among the existing terminals in Delhi area to achieve the above-mentioned objective.

5 – 4 – 1 New Delhi's Eligibility

From the viewpoints not only of the railway transportation efficiency but also of the city planning of the Delhi area, there are two options conceivable in dealing with the increasing number of trains and passengers flowing into the area.

A Accept them at one of the selected existing railway terminals in the city centre of Delhi area, which, the terminal, will be adequately improved and fully utilized.

B Divide and accept them at some existing or new directional terminals, which will be selected avoiding the city centre, where new passenger facilities will be created or improved.

The option A is recommended. The reasons are as follows:

1) At present, the New Delhi Station is the core of the railway network of the Delhi area. As such, it is and will be dealing with most of the Mail/Express trains. Option A will be the least

demanding option for the convenience of the passengers, because it is not necessary for the users to change the present travelling behaviour.

2) The New Delhi Station will have enough space for the additional passenger facilities, if its goods handling is shifted to somewhere else. Option A will make the required investment minimal because the existing facilities could thus be utilized. While Delhi Main is limited in this flexibility.

3) The New Delhi's east front plaza is in good conditions and ready in space for further improvement of access to the Ring Road. The examples of the improvements are; expansion of the plaza toward the Ajmeri Gate side, grade separation of car-access space, etc. When these improvement is done, Option A will not worsen the congestion of the city centre.

4) When other conditions are the same, the most efficient way of handling trains is to deal with as many of them as possible at a single modernized station. Option A will serve for this purpose.

The Option B is not adopted. The reasons are as follows:

1) There are opinions to the effect that the concentration of railway passenger handling to one single station in the city centre would emanate further congestion of roads around it. But survey tells that the existing disturbance around the New Delhi Station (at East/West front plazas and Ajmeri Gate Road Bridge) derives from the co-existence with automobiles of the low speed carriages powered by men, horses, oxen which counts 25 ～40% of the flow. It can be expected that such traffic will be replaced in near future by automobiles.

2) At the same time it is to be noted that the decentralization of railway passenger handling from New Delhi Station could not be the final solution of the road congestion. Because it will give rise to a remarkable increase in additional flows of road traffic

linking these terminals and the city centre. Neither could it be the final solution of the problems railway faces with. Because the line capacity bottlenecks will remain the same even if the passenger terminals were to be decentralized. The final solution cannot be provided otherwise than to create a track-typed mass transit system in Delhi area.

Based upon the above-mentioned concepts, the utmost improvement and utilization of New Delhi as the BG passenger terminal in Delhi area should be given the highest priority.

In order, however, to cope with the predicted passenger traffic increase after 2000, plans should be prepared, first, to develop the urban mass transit system within Delhi area and, second, to develop some directional terminals in the periphery of Delhi area for complementary use.

5 - 4 - 2 Viability of the Solution

New Delhi Station will undergo a large scaled improvment. How many years could the improvement keep being effective ? This paragraph deals with this question.

(1) Requirements and acceptability.

Table 5.4.1 shows the numbers of BG passenger trains to be dealt with at New Delhi and Delhi Main. They are given year-wise and direction-wise.

Figures given in Table 5.4.1 show the number of trains which would become necessary to be operated, when no modification is made to the present mode of train operation at large and when no limitation is assumed as to the New Delhi Station's train handling capacity. It should be based on these figures that the sizes of the future terminals in Delhi area will be planned.

The planning sequence will be as follows:

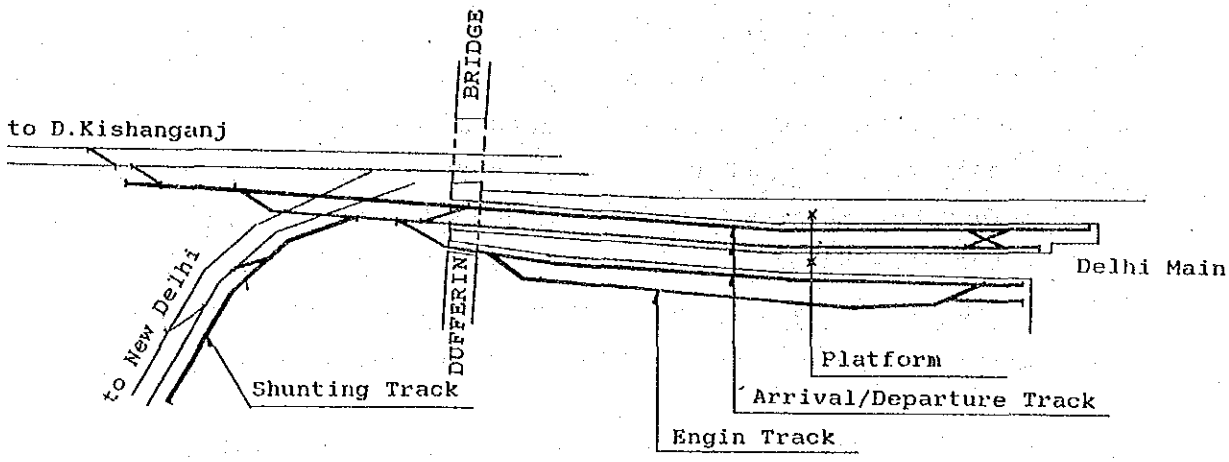
1) A number of arrival/departure lines will be built in Delhi Main at the space created by removing its MG train handling facilities. Utilizing these newly built facilities a number of additional trains will be palnned at Delhi Main.
2) Those trains which will overflow Delhi Main will, by the first planning priority, be dealt with by New Delhi improved.
3) Those trains which will still overflow New Delhi will be dealt with by the directional complementary terminals, considerations always given to the capacities of the lines involved.

Table 5.4.1 Number of Trains Handling in Delhi Area

Station	Year	Arrival	Depart.	Switch B.	Through	Total
New	1988	26	26	11	63	126
Delhi	1995	34	34	11	73	152
	2000	56	56	11	73	196
	2005	88	88	11	73	260
	2010	115	115	11	73	314
Delhi	1988	27	29	23	40	119
	1995	30	32	23	56	141
	2000	34	36	23	56	149
	2005	57	57	23	56	193
	2010	86	86	23	56	251
Total	1988	53	55	34	103	245
	1995	64	66	34	129	293
	2000	90	92	34	129	345
	2005	145	145	34	129	453
	2010	201	201	34	129	565

(2) Number of trains which can be treated at Delhi Main

Fig. 5.4.1 shows the arrival/departure lines to be constructed in Dehi Main, at the space created by moving its MG passenger facilities to Patel Nagar. 149 trains will be able to be planned (Planning sequence 1) above). The number of trains increasing after the year 2000 will be dealt with at New Delhi, (Planning sequence 2) above). The total number of trains to be treated at Delhi Main will be as shown in Table 5.4.2.



approximate cost ..... Rs 39 million

Fig.5.4.1 Improvement Plan for BG Facilities at MG of Delhi Stn.

Table 5.4.2 Number of Trains to be dealt with at Delhi Main

	1988	1995	2000	2005	2010
Arrival	27	30	34	34	34
Departure	29	32	36	36	36
Turn-Back	23	23	23	23	23
Through	40	56	56	56	56
Total	119	141	149	149	149

(3) Durability of the solution

It will be possible to build the passenger facilities given in the Table 5.4.3, in the space at New Delhi created by removing its BG goods facilities, and in the space at Lahori Gate created by removing its MG goods facilities.

Table 5.4.3 Largest Possible Improvements at New Delhi within Available Space

Tracks	Existing Facilities		Possible Facilities	
	Number	Length in number of coaches acceptable	Number	Length in number of coaches acceptable
Platforms	11	15 to 22	16	26
Washing Lines	9	9 to 21	16	26
Stabling Lines	7	varying length	8	26
Sick Lines	2	varying length	8	12

The above-mentioned facilities will be constructed according to a track layout plan shown in the next Chapter, Fig. 6.4.1. This plan will enable New Delhi Station to deal with 230 trains in total, that is, to cope with the traffic demand estimated for the year 2005. After 2005, some directional terminals will become necessary to deal with the trains which will overflow New Delhi.

Table 5.4.4 Number of Trains to be dealt with at New Delhi

	1988	1995	2000	2005	2010
Arrival	26	39	67	73	73
Departure	26	39	67	73	73
Turn-Back	11	11	11	11	11
Through	63	73	73	73	73
Total	126	162	218	230	230

Note: Considering the capacities of the train maintenance work at other stations, all increasing trains are planned originate/terminate at New Delhi, and number of Turn-Back and Through trains are the same as the Action Plans'.

(4) Investment Plan

The investment amount and the schedule of the improvements of New Delhi described in 5-4-2 (3), above, is shown in Table 6.2.1 in chapter 6. An apporoximate improvement cost is Rs.1431 million excluding the facilities already sanctioned.

5 - 4 - 3 Directional Terminals

Some directional terminals will have to be planned, for one thing, considering the limitation in the terminal capacity of New Delhi as was mentioned in the preceding paragraph, and for another, considering the limitation in the line capacity for certain line/sections within Delhi area leading to New Delhi.

The number of trains which will have to be dealt with at terminals other than Delhi Main and New Delhi, is shown in Table 5.4.5.

Table 5.4.5 Direction-wise Numbers of Trains

Year	Tundla Hapur	Mathura	Ambala
2009-2010	56	28	20

Four terminals must be improved (or constructed) to deal with these trains of three directions.

(1) Ghaziabad

Ghaziabad must be strengthened to deal with the passenger trains of the directions Tundla, Hapur and Meerut, since there will be problems in the line capacity to bring them from these directions to New Delhi.

The improvements of Ghaziabad include 3 arrival/departure lines and 16 washing/stabling lines.

Approximate Cost RS 189 million

(2) Anand Vihar

For the same reason, a new terminal will be constructed at Anand Vihar, with 2 arrival/departure lines and 11 washing/stabling lines.

Approximate Cost RS 266 million

(3) Tuglakabad

Tuglakabad must be improved to deal with the passenger trains of the direction Mathura.

The improvements will include

2 arrival/departure lines and

13 washing/stabling lines

Approximate Cost RS 125 million

(4) Holambi Kalan

Passenger handling facilities must be added to Holambi Kalan (Goods) (which itself will have been completed by 1995), to deal with the passenger trains of the direction Ambala.

The additional facilities will include

2 arrival/departure lines and

9 washing/stabling lines

Approximate Cost RS 171 million

5 - 5 Terminal Location and Investment Plan

To recapitulate the terminal location plan described in 5-1 through 5-4 above, the sequence of the improvement works will be as follows:

Earlier Period

(1) Construct the washing lines and stabling lines at Nizamuddin, as currently planned and on-going.
(2) Construct a passage line from Tilak Bridge to Nizamuddin, at the same time as (1) above is done.
(3) Move the passenger-car maintenance work now being made at New Delhi to Nizamuddin.
(4) Construct two platforms in the space in New Delhi yard where the present passenger-car maintenance facilities are removed by (3) above.

The above-mentioned steps (1) through (4) are already being executed. The steps below are to follow them.

(5) Move the New Delhi goods facilities to Kishanganj and other nearby goods terminals.

(6) Build washing/stabling lines in the space thus created in New Delhi. The construction at New Delhi of four platforms, improvements of the station buildings and of station front plaza are to follow.

(7) Construct a BG goods terminal at Holambi Kalan.

(8) Construct a goods terminal at Bijwasan, to deal with the loading/unloading of MG goods and to deal with the transshipment MG-BG.
Move the MG goods facilities at D. Lahori Gate and Sarai Rohilla to Bijwasan.

(9) Improve Patel Nagar as an MG passenger terminal, move there the MG passenger handling now being made at Delhi Main.
Construct the maintenance facilities for MG passenger trains at Sarai Rohilla.

The above-mentioned steps (5) through (9) should be completed by 1999-2000.

Later Period

(1) Construct additional platforms at New Delhi Station and build washing/stabling lines at D. Lahori Gate where the MG goods passenger facilities will have been removed.

(2) Improve and construct passenger terminals at Ghaziabad, Anand Vihar, Tuglakabad and Holambi Kalan to deal with the trains increasing after 2000.

The investment amount and schedule of the above-mentioned works is shown in Table 5.5.1. The works include those for the related sections and those for removing the bottleneck points in Delhi area.

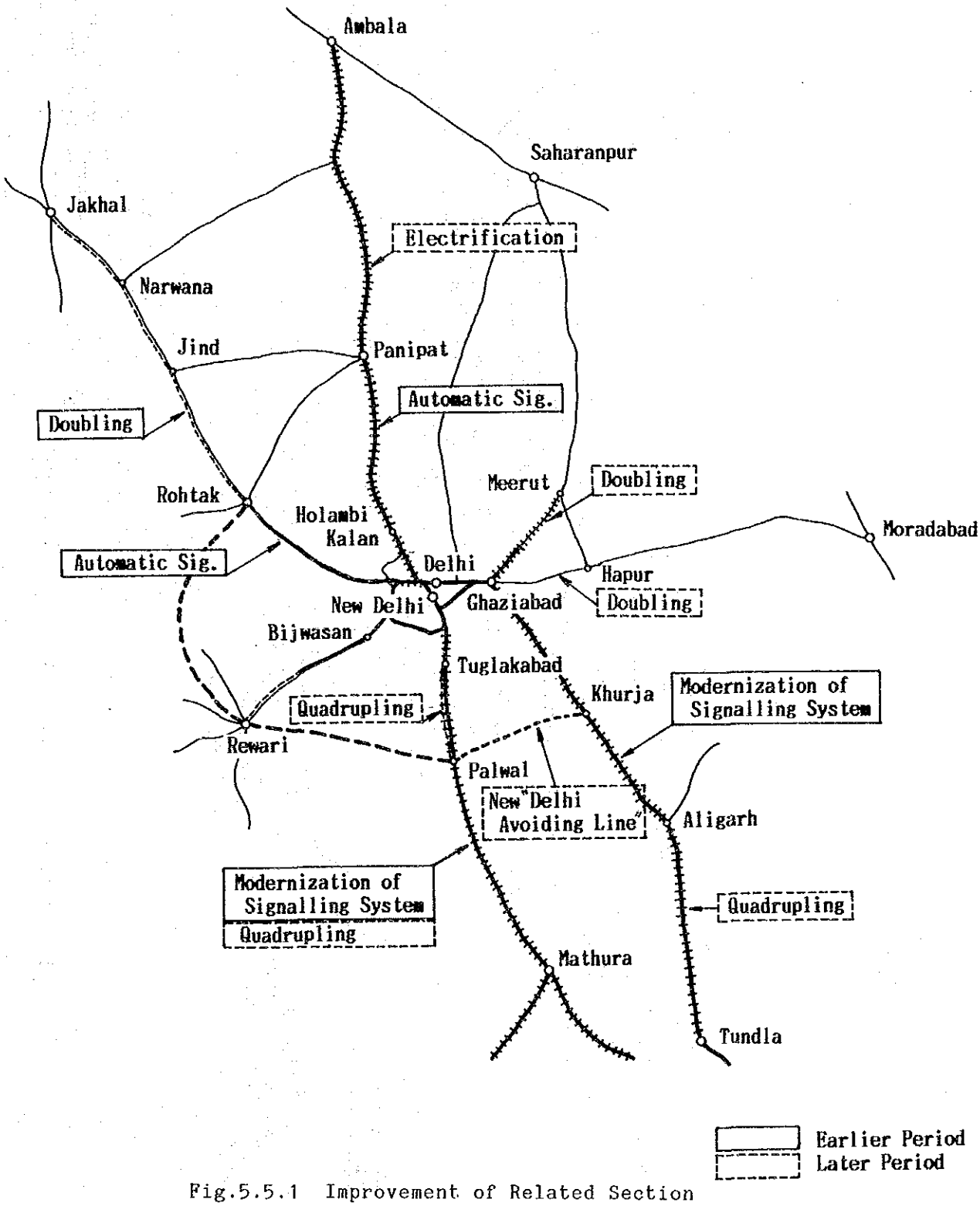


Fig.5.5.1 Improvement of Related Section

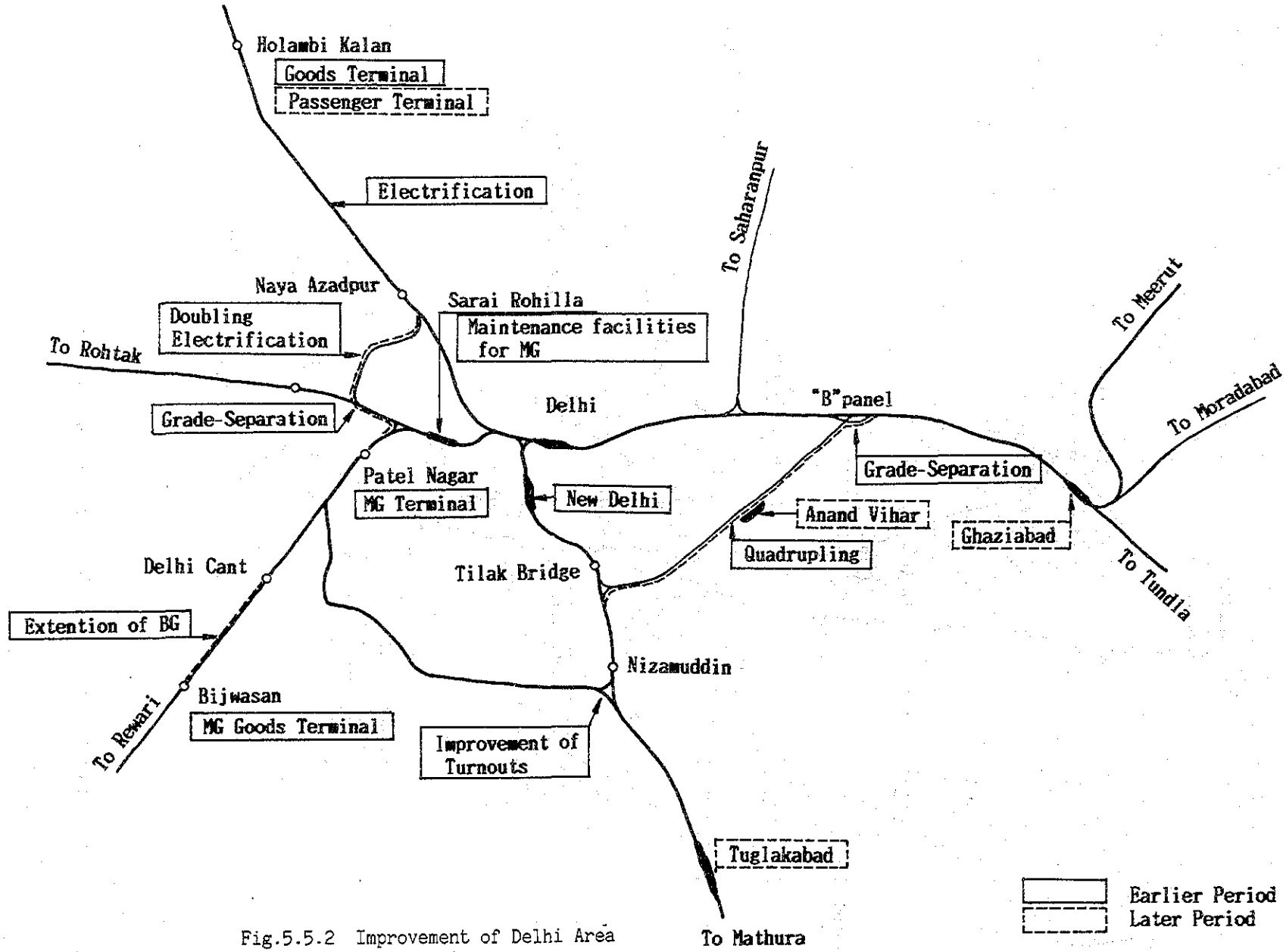


Fig.5.5.2 Improvement of Delhi Area

Table 5.5.1 (1) Investment Schedule

Improvement Section/Terminal		Construction Cost (Million Rs)	Fiscal / Year 1989 90 – 1994 95 – 1999 2000 – 2004 05 – 2009 10
Earlier Period Relevant Section			
· Ghaziabad ~ Tundla	Modernization of Signalling System, including improvement turnouts and OHE etc.	690	
· Delhi ~ Holambi Kalan	Electrification	69	
· Naya Azadpur ~Ambala	Automatic Signalling	185	
· Shakur Basti ~Rohtak	Automatic Signalling	94	

Note : "Doubling," "Tripling," "Quadrupling," mean Track doubling, Track tripling and Track quadrupling, respectively.

Table 5.5.1 (2) Investment Schedule

Improvement Section/Terminal		Construction Cost (Million Rs)
(Rohtak ～Jakhal Doubling)		
-Rohtak ～Samar Gopalpur, Kinana ～Barsola, Ghaso～Jakhal		
-Samar Gopalpur ～ Kinana		195
-Barsola～Ghaso		104
・Palwal ～Mathura	Modernization of signalling system	192
・Patel Nagar ～Rewari	Automatic Signalling	112
Sub total		1641

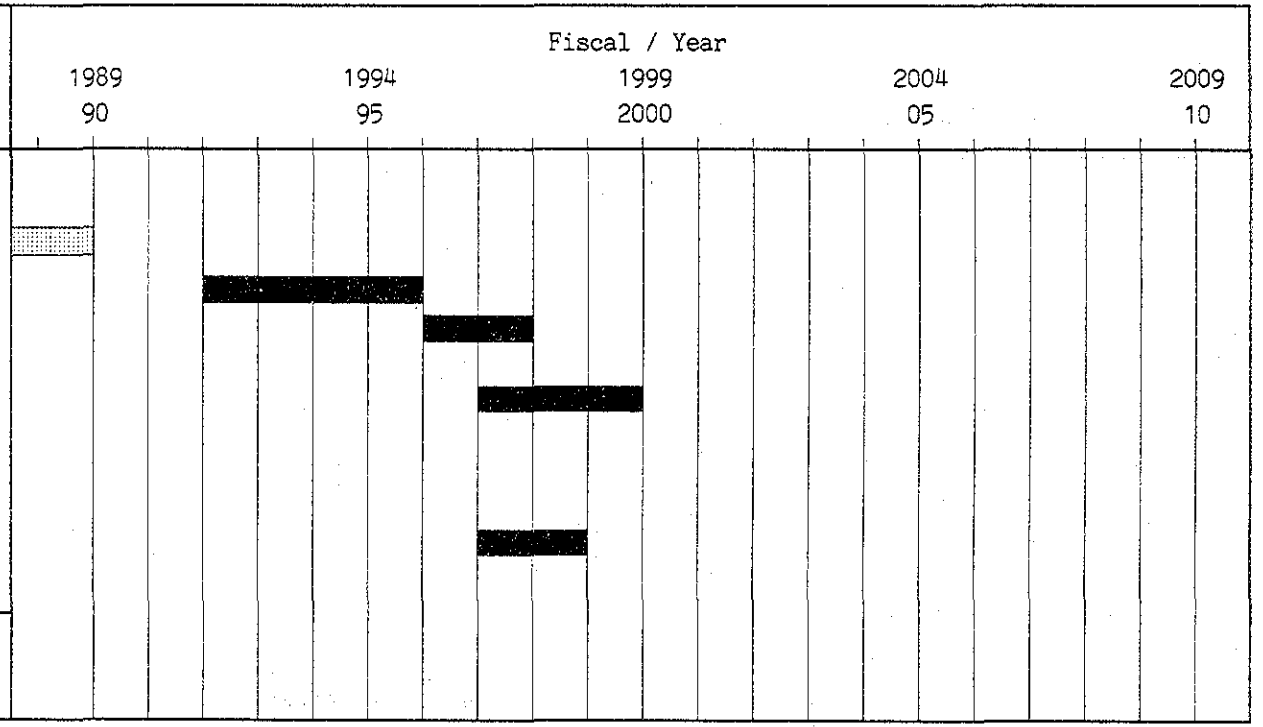


Table 5.5.1 (3) Investment Schedule

Improvement Section/Terminal		Construction Cost (Million Rs)
Delhi Area		
・Rampura Cabin ～Naya Azadpur	Grade-separation, Doubling	116
	Electrification	33
・Tilak Bridge ～ Sahibabad	Quadrupling Grade-separation at "B" panel	330
・Delta area at Nizamuddin	Improvement of turnouts etc.	11
・Delhi Area Absolute Block section	Automatic Signal-ling	39
Therminal		
・Nizamuddin (PhaseⅡ)	Washing & stabl-ing line	—

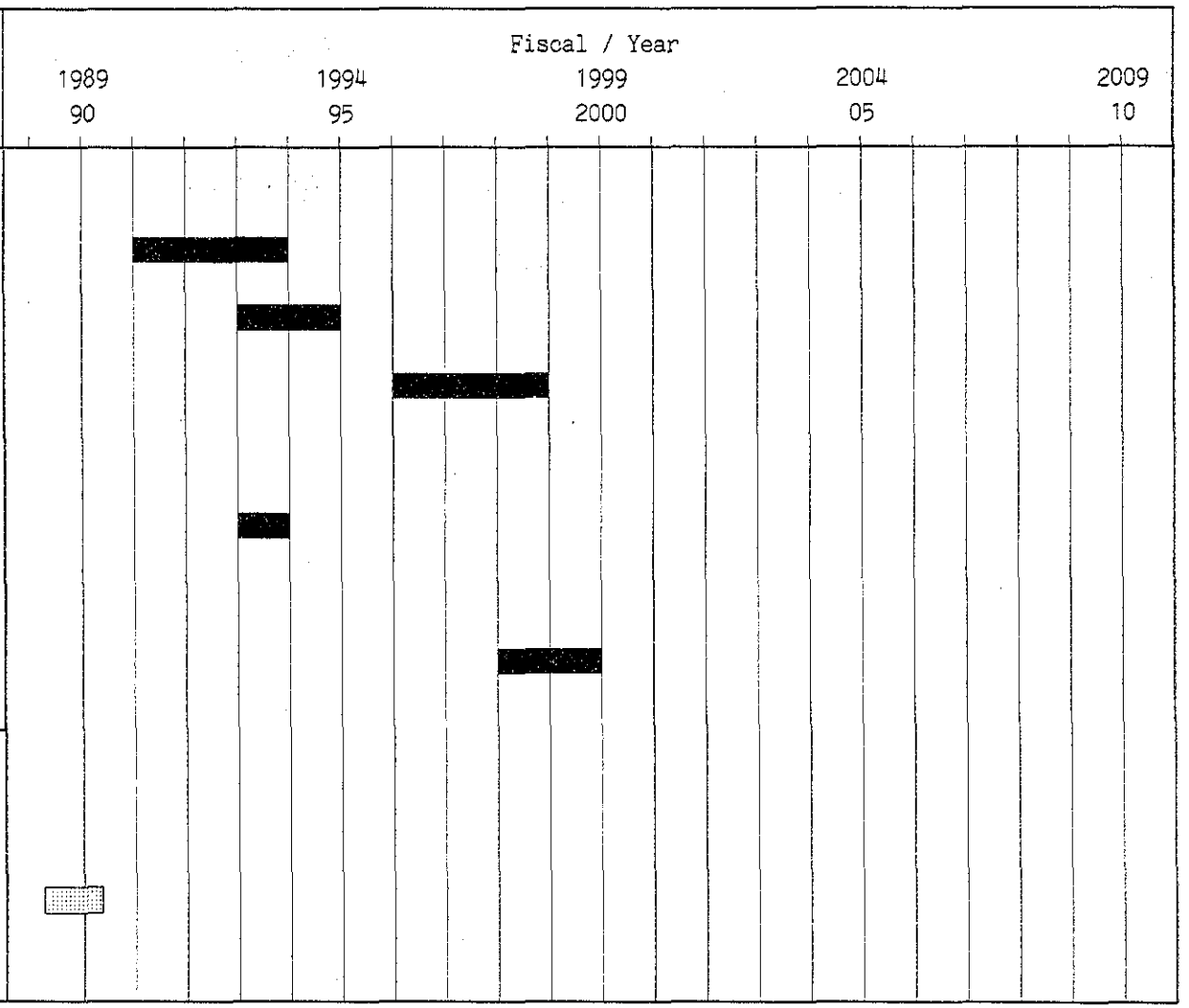


Table 5.5.1 (4) Investment Schedule

Improvement Section/Terminal		Construction Cost (Million Rs)
・New Delhi (Phase Ⅰ)	2 platform faces	—
・Holambi Kalan	Goods facilities for New Delhi	258
・Bijwasan	MG goods facilities	280
・Patel Nagar (including maintenance facilities at Sarai Rohilla)	MG passenger facilities	174
・Delhi	(BG facilities at MG)	35
・New Delhi (Phase Ⅱ)	3 Platform faces Washing & Stabling lines	333
・New Delhi (Final phase)	New station building including passenger information	1098

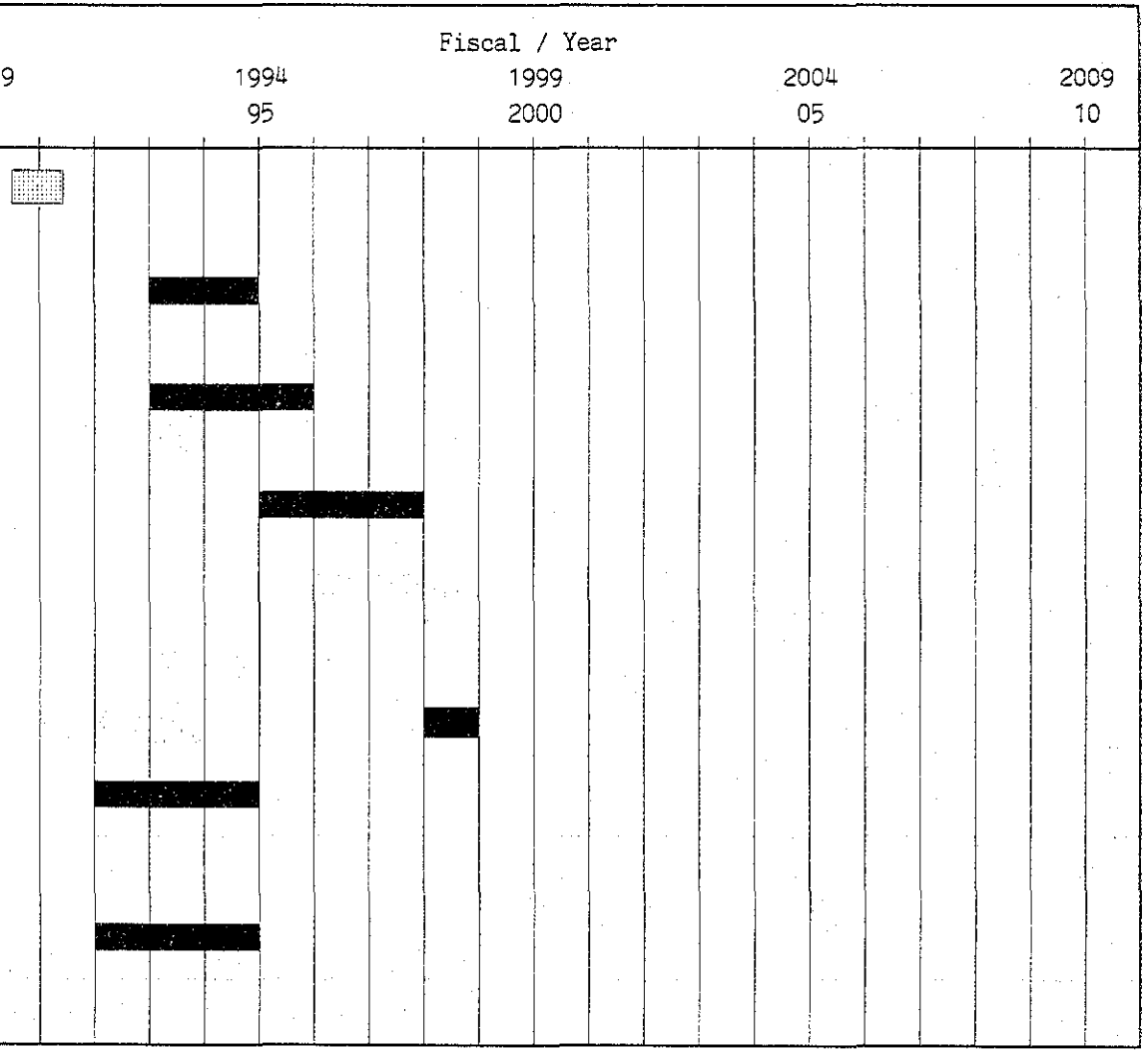


Table. 5.5.1 (5) Investment Schedule

Improvement Section/Terminal	Construction Cost (Million Rs)	Fiscal / Year 1989 90	1994 95	1999 2000	2004 05	2009 10
Sub total	2707					
Total (5 Years each)	4348		3,056	1,292		

Table 5.5.1 (6) Investment Schedule for Later Period Projects

Improvement Section/Terminal		Construction Cost (Million Rs)	1997 98	1998 99	1999 -2000	2000 -01	2001 -02	2002 -03	2003 -04	2004 -05	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10
Later Period Section															
・Ghaziabad ～Khurja	Tripling	360													
・Khurja～Tundla	Quadrupling	2340							Tripling		Quadrupling				
・Khurja～Palwal Rewari～Rohtak	New "Delhi Avoiding Line"	3850							New line						
・Tuglakabad ～Palwal	Quadrupling (3→4track)	440													
・Palwal ～Mathura	Quadrupling	1610			Tripling			Quadrupling							
・Ghaziabad ～Hapur	Doubling	210													
・Murad Nagar ～ Meerut City	Doubling	170													
・Holambi Kalan ～Ambala	Electrifi-cation	530													

Table 5.5.1 (7) Investment Schedule for Later Period Projects

Improvement Section/Terminal		Construction Cost (Million Rs)	1997 98	1998 99	1999 -2000	2000 -01	2001 -02	2002 -03	2003 -04	2004 -05	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10
Terminal															
· New Delhi Station	Platform & Washing/Stabling. Tracks station building	125													
· Holambi Kalan	Passenger Facilities	171													
· Anand Vihar	Passenger Facilities	266													
· Tuglakabad	Passenger Facilities	125													
· Ghaziabad	Improvement of Passenger Facilities	189													
Later Total		10,386													

CHAPTER 6 IMPROVEMENT PLAN FOR NEW DELHI STATION

CHAPTER 6 IMPROVEMENT PLAN FOR NEW DELHI STATION

The transportation planning and the new function assignment of terminals in Delhi area, have been made in the preceding chapters. The new role New Delhi should play in the whole picture has now been clarified. This chapter deals with the concrete plans for installations and equipments to implement this role.

6 - 1 Preconditions for Improvement Planning

6 - 1 - 1 Assumptions in Transportation Planning

Assumptions in transportation planning are as follows:

(1) Passenger transportation

New Delhi Station is considered to be the main terminal in Delhi area, dedicated for passenger trains. The number of trains dealt with at this terminal is assumed for the year 1999-2000 as is given in Table 5.4.4. There will be 54 trains originating/terminating, 11 trains turning back and 73 trains passing through this terminal. As a total, in the year 1999-2000, there will be 192 trains dealt with per day.

(2) Goods transportation

There will be no goods trains treated here in 1999-2000. For the time being, all of them will have been moved to the nearby existing goods stations. MG Good equipments at Lahori Gate will have been moved to Bijwasan.

(3) Parcel/luggage trains

At present, both parcels and luggages are being handled at New Delhi Station. But it is assumed in this Project that the parcel transport will be containerized. Parcels will be accepted and entrained/detrained at other terminal and New Delhi would not deal with them.

Luggage handling will remain. It is assumed to be treated in the same way as it is today, that is, on the same passenger platforms.

6 – 1 – 2 Requirements for Facilities

(1) The space of D.Lahori Gate for MG goods and BG goods must be assigned to passenger car washing/stabling lines of New Delhi.

(2) The existing station buildings and platforms etc., must be utilized as much as possile.

(3) The track layout must be modified so that the use of the main line tracks might least compete between the on-serivce trains and out-service trains. ("On-service trains" mean the trains in commercial service. "Out-service trains" mean those being shifted to/from washing/stabling lines)

(4) The track layout must be modified so that a platform might be used for trains of various directions. The track connection between the platforms and the arriving/starting lines must be so designed.

(5) The new platforms to be built must be designed so that they could deal with 26 car trains. The same with the washing/stabling lines.

(6) Part of the car washing works must be mechanized.

(7) Investments for improving luggage handling must be minimized, in consideration of its probable changes in method of transportation in future.
But their moving lines must be separated from those of the on platform passengers at the places where luggages will cluster.

(8) No large scaled commercial development of the station will be planned.

(9) The station building layout must be designed so that the moving lines of station users might not interrupt each other. The same with the moving lines of cars gathering at the station front plaza.

6 - 2 Yard Improvement Plan

6 - 2 - 1 Improvement of Track Layout

(1) Fundamental items for track layout

The project has some innate difficulties whose total rectification would cost too expensive, or involve too many interests concerned. The planning must be started accepting them as given facts. They are:

1) A curve of R=450m at the entry to the station from Tilak Bridge direction, and the Minto Road Under Bridge of about 20m width
2) Ajmeri Gate Road Bridge
3) Difficulty of land acquisition
4) Difficulty of modifying the location of the existing platforms and loco-sheds.

Taking them for granted, and planning within their limitations, it is aimed to design a new track layout so that;

1) It might least restrict the train speed when it enters and leaves the yard.
2) The track use might be most simplified and the shunting lines and engine lines might be placed as far from the main line as possible.
3) The new stabling track etc., might be designed long enough to accommodate a train of 26 car-consist.

(2) The Planned Track Layout

Principal dimensions of the track layout are given in Table 6.2.1 and an conceptual design is shown in Fig. 6.2.1.

Table 6.2.1 Principal Dimentions of the Track Layout

Till 2000	Effective length(m)	Number of lines
Arrival/Departure	600	4
Washing line	600	12
Stabling line	600	4
Sick line	280	6

After 2000	Effective length(m)	Number of lines
Arrival/Departure	600	1
Washing line	600	4
Stabling line	600	4
Sick line	280	2

Note: Number of washing/stabling lines are planned considering the maintenance facilities at Nizamuddin.

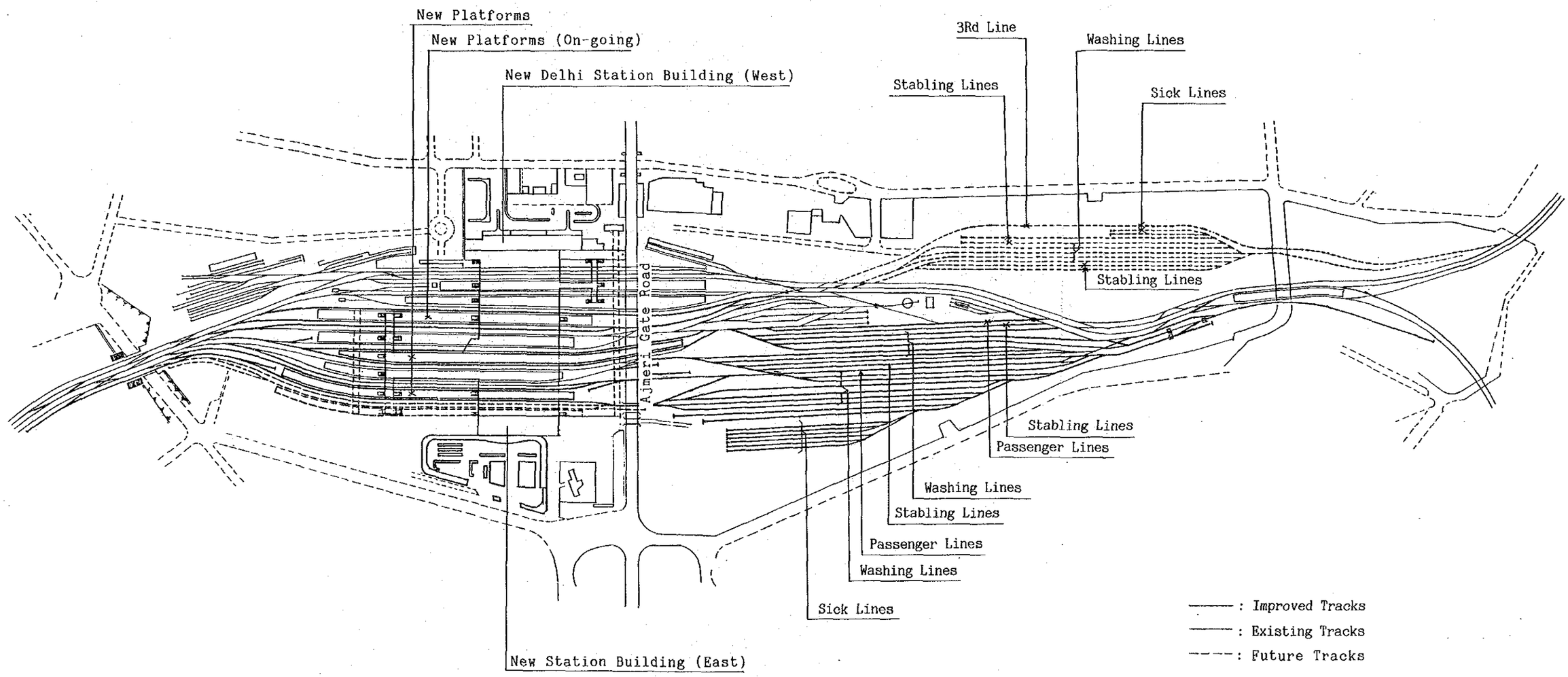


Fig.6.2.1 New Delhi Station Conceptual Plan

6 - 2 - 2 Reconstructing Plan of Major Structures

Shivaji Road Underbridge and Ajmeri Road Overbridge must be reconstruted to effectuate the track layout improvement of the New Delhi yard.
Shivaji Road Underbridge will be widened by approximately 5 metres (keeping its existing type of structure), in order to create a space for an one additional track.

Ajmeri Road Overbridge will be reconstructed in the following way.

- A tunnel with the width sufficient for two additional tracks will be dug through under the east side embankment of the bridge.
- The tunnel will be of an arch section the same as the adjacent (existing) ones, if architectual harmony should be considered. When this consideration is not necessary, PC girder or composite girder structure will do. This would be cheaper in cost and easier in construction work.
- In both cases, the structure gauge of the tunnel requires the Ajimeri road gradient to be modified so that the road could be raised by approximately one metre at the point of the new tunnel.

6 - 2 - 3 Yard Reconstruction Planning

(1) Track switch-over steps

The track improvement work in New Delhi yard must be implemented without influencing the normal train operation. Careful steps should be followed to smoothly switch the existing track layout to the new one. The following precautions are required:

1) In planning the switch-over steps, the possible work volume which can be executed at one step must be carefully studied. The same with the time required for one step to be performed, and the interval between one step to the next, where train operation is suspended. Depending on cases, the planner should be prepared for suspending a considerable number of trains. This might often minimize the total loss.
2) A track switching is always accompanied with other switching

works related to signalling, catenary, structure, building etc. A perfect coordination must be secured among them.

3) The construction cost and time will increase proportionally to the number of switch-over steps. The number of steps should therefore be economized, while the substantial work volume at one step should be maximized. For this purpose, non-substantial works, which could be done prior to the step, should be performed to the utmost extent.
Preparatory placing of tracks and switches beside the regular place of installation will often contribute to the economization of the number of switch-over steps.

(2) Fig.6.2.2 shows, for reference sake, an example of switch-over steps considered for improving New Delhi track layout.

6 - 2 - 4 Auxiliary Facilities in the Station Yard

(1) Water Supply and Drainage

1) Water Supply

Water supply to New Delhi yard is composed of two pipe line systems: one for filtered water and the other for unfiltered water. The water sources are the main pipes of the Municipality Corporation of Delhi in the Thompson Road zone, Ram Nagal zone and Pharganji zone. There are also open wells in the yard.
Filtered water is for drinking and supplied to the station buildings, passenger coaches, passenger platforms, staff offices, (maintenance personnel and others) in the yard.
Unfiltered water is for the washing and cleaning of trains and supplied to platforms and washable aprons.

A partial dismantling and alteration of the existing piping will be made. Construction of new pipe lines to the station

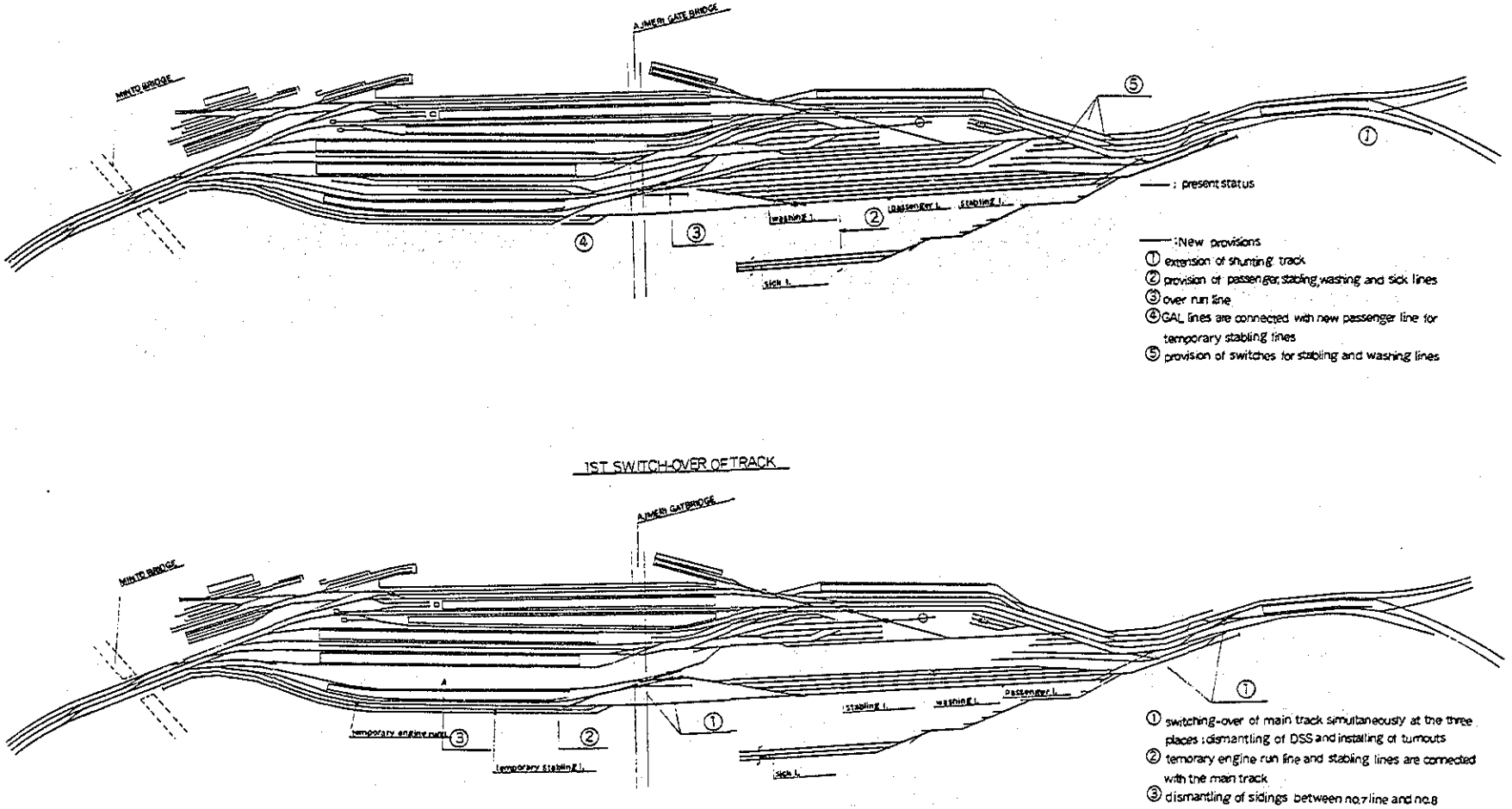


Fig. 6.2.2 (1) Switch-over Steps in New Delhi Yard

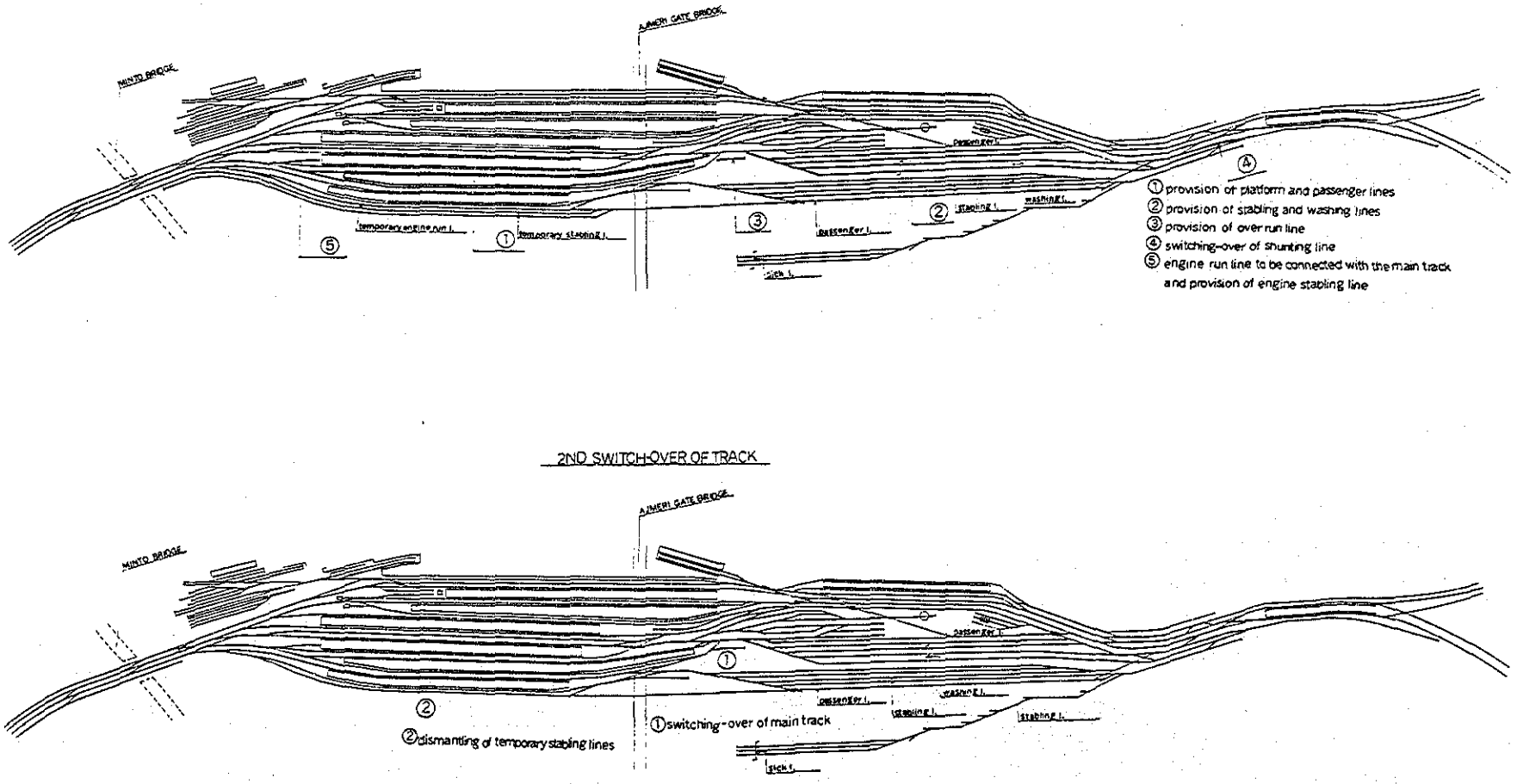
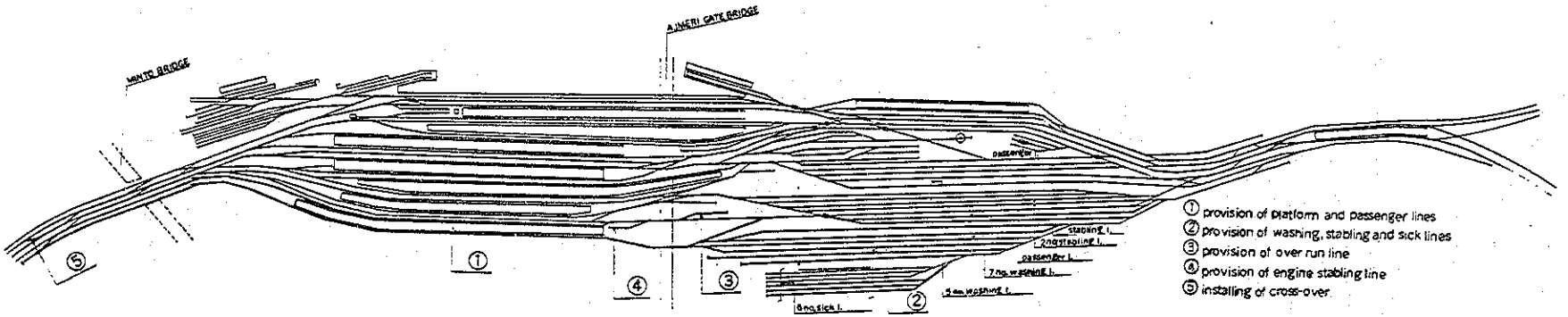


Fig. 6.2.2 (2) Switch-over Steps in New Delhi Yard



3RD SWITCH-OVER OF TRACK

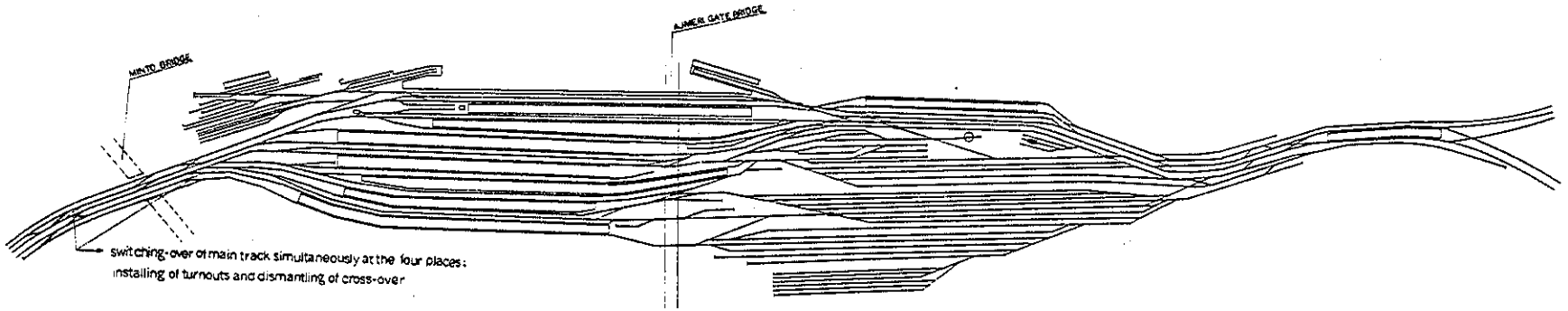


Fig. 6.2.2 (3) Switch-over Steps in New Delhi Yard

building, passenger platforms, washing lines etc will also be carried out for the modernization of the station yard.
To keep stable water pressure, pipe sizes of 150mm diameter for the underground main, 100mm for filtered water and 80mm for unfiltered water will be used.
Water hydrants will be furnished every 12.2meters for both filtered and unfiltered water pipes at washing lines and washable aprons. They are for the purpose of feeding water to trains, and for washing and cleaning passenger coaches and aprons.

Further study will be necessary to determine accurate piping work at the time of detail design, since there are some uncertain factors such as water consumption and its fluctuation at respective places in the yard.

2) Drainage

The yard will be provided with a system of draining the rain water and the waste water. The rain water is collected in the side-ditches midway between two tracks. The side-ditches are connected to surrounding ditches through crossing pipes, then the rain water flows into a drain box and discharged to the main pipe line.

The waste water involves the drains from the washing lines and washable aprons as well as miscellaneous sewage from the station building etc. The drain from the washing line is collected in ditches along the washing deck. The ditches connect to crossing pipes placed every 50 meters through a drain box and to the longitudinal sewer pipe. The drain is discharged to the city sewerage main line.

It is important to furnish an adequate gradient to the sewer lines to prevent the stagnation of waste water in the drainage system. At the detail design stage, a survey of the maximum rainfall record will be necessary to determine the optimum sewer section.

(2) Passenger Coach Washing Complex

The present method of washing the coach exteriors is manual washing. It is performed by 12 teams at the washing lines. Four men comprise one team, and their washing efficiency is 40 coaches per every 8 hours. The number of terminating trains at New Delhi Station is expected to reach 54 by the year 1999-2000. The installation of a mechanical washing complex would shorten the occupancy of the washing lines securing thus the train operation schedule intact.

A washing complex will be built at the neck of the shunting lines on Delhi side. The train to be washed will pass through the complex (one directioned). Detergent will be sprayed to the car-bodies at a point and the water-rinse unit will be placed at a certain distance from the point. Train speed while passing the complex is normally less than 5 kilometers per hour (83.3 meters/minute). The actual time required for washing will be approximately 8.5 minutes for a train of 22 coaches. The maintenance work at washing lines will be shortened from 4 hours (at present) to 3 hours.

(3) Electrical Facilities

1) OHE

About 10㎞ of OHE and return wire are newly constructed, and about 8km of OHE is dismantled for improvement of the yard.

2) Substation

New substation is provided in the station building, which will serve to the station and yard.

3) Power distributing lines

415V, PVC underground cable line is constructed between the substation and washing lines, sick lines.

4) Lighting facilities

The pit lighting and polelight are provided at washing lines.

5) Power feeding for coach

The AC. 415V feeding equipments are installed at platform, passenger lines and stabling lines.

6) Battery charging facilities for coach

Battery charging facilities are provided at platform, passenger lines and stabling lines.

6 - 3 Passenger Facilities Planning

6 - 3 - 1 Passenger Flow and Problems

(1) Passenger Flow Survey

In order to plan the passenger facilities of New Delhi Station, a survey was conducted Jan. 31-Feb.1.1989 to identify the flows of station users/passers and road vehicles. The total number of people entering and leaving the station was 249,700 per day. Of these, 129,628 persons passed through the West Gate; namely, 13,656 and 19,701, respectively, at the entrance and exit located at the foot of the overpass on the Nizamuddin side, and 47,516 and 48,755 respectively, at the remaining two entrances and three exits. At the East Gate, a total of 69,215 persons passed through, or 34,479 in and 34,736 out at the foot of the overpass on that side.

Three peaks were observed per day, and the single largest one-hour peak of passers was recorded at 5,577 in and 4,289 out, a total of 9,866, at the foot of the East Gate's overpass.

The concentration rate (9,866/69,215) for that peak is about 15%.

(2) Future Passenger Flows

Passenger transport volume in 2010 will be twice as large as at present, due to the increase of 76 passenger trains of longer consists. It is also estimated that in 2010 the total number of people entering and leaving New Delhi Station will be approximately 500,000, with the maximum number of people passing through a gate being 20,000 per hour. Furthernmore, the number of pedestrians who will use the free passage will be 60,000 per day.

(3) Passenger Flow Problem

As to the passenger facilities of this station, their limit has almost been reached. It is evident that they should be improved in order to cope with the passenger increase expected in the near future. At present, during the peak hours when a large number of long-distance trains arrive, heavy congestion is observed at the entrance and exits of the platforms and overpasses. They are thronged with passengers carriyng large personal belongings, which make the congestion even worse. The main problems have been identified as follows:

(1) The moving lines of passengers are too complicated. On the platforms, these lines have to avoid the parcels/luggage stacked here and there. In the concourse, they get even more complicated because they crisscross with the lines of other passengers bound for different directions. On the overpasses they also intermingle with ordinary pedestrians (nonrailway users).

(2) Passengers stagnate on the concourse and platforms, since there is too little space. Actually, the space per person should be designed in this terminal to be larger than normal.

(3) The locations of certain service facilities are not easy to find. and there are not enough public signs indicating them.

All these problems must be solved by structurally improving the entire station.

6 - 3 - 2 Station Building Planning

(1) Aims

There are three major aims of the improvements:

(1) Separate the flow of non-passengers (i.e., pedestrians) using the free passageway from the passengers getting on/off trains.

(2) Lay out appropriately the passenger facilities in full respect of the improved moving passenger lines.

(3) Secure more space per person than normal in designing the passenger facilities of this terminal.

These aims must be implemented in a plan which can be well justified by the results of the passenger flow survey, by the predicted passenger flows of the future, and by the realistic evaluation of the utilization status of the facilities.

The facilities needed for smooth entraining/detraining and for promoting smooth passenger flow are as follows:

"Passenger Facilities"
- Flow Facilities
  - Station front plazas
  - Halls
  - Concourse
  - Free passageway for pedestrians
  - Passageways for entraining/detraining passengers
  - wickets, etc.
- Amenity Facilities
  - Waiting rooms
  - Restaurants (Refreshment room)
  - Kiosks
  - Public telephone booths
  - Water closets, etc.

"Service Facilities"
- Sales Facilities"
  - Ticketing booths
  - Parcel/luggage handling office
  - Information counters, etc.
- Management Facilities
  - Station master's office
  - Meeting rooms

Maintenance staff rooms
Other station staffs' rooms
Machine rooms, etc.

"Miscellaneous Facilities"
Tourist information office
Post office
Other facilities for public use.

(2) Plan

1) Dimensions

a. Over-track building newly built: Flow/Sales/Amenity Facilities.

— steel structured
— two floored
— 27,000㎡

b. Management Facilities

See 4) and 5)

2) Main features

The renewd station is featured in the following points:

(1) A free passage for non-passengers, of a steel structure with width of 30 metres is built crossing the station above the platforms.
On both sides of the passage are placed the waiting rooms, ticketing offices and shops. The total width of the structure including these facilities is 85 metres.

(2) Connecting this upper floored passage with the both gates at ground level are the staircases with an escalator on each side (upward and downward)

(3) The concourses inside the wickets are 12 metres wide at the narrowest. The starcases are 8 metres wide in an average. This will do to the decrease of congestion.

(4) Ticketing offices and wickets leading to the platforms are installed at four places taking into account the passenger flows.

(5) Porter shelters are installed at the East Gate, West Gates and the concourse inside the wickets.

3) Space allocation

The space alloted to the above-mentioned facilities are as listed below:

Waiting Room		
1st. Class Gents Waiting Room	600	
1st. Class Ladies Waiting Room	250	
2nd. Class Gents Waiting Room	750	
2nd. Class Ladies Waiting Room	250	
Subtotal	1,850	㎡
Refreshment Room Vegetarian	150	
Non Vegetarian	150	
Base Kitchen Vegetarian	150	
Non Vegetarian	150	
Snack Bar	200	
Subtotal	800	㎡
Drug Store	100	
Book Store	100	
Travel Goods Store	100	
Florist	100	
Cake Shop	100	
Telephone Booth	150	
Subtotal	650	㎡
Emergency Center	150	
Enquiry Information	100	
Railway Information Center	200	
Booking Office	450	
Ticket Stock Room	100	
Extension Charge Counter	100	
Station Master's Office	100	
Station Staff Office	300	
Porter Shelter	200	
Subtotal	1,700	㎡
Tourist Information	200	
International Tourist Bureau	200	
Events Information	50	
Bank	300	
Post Office	300	
Police Station	50	
Subtotal	1,100	㎡
Total	6,100	㎡

Note: The free passage crossing the station is approximately 15

metres high from the deck to the ceiling. Utilization of the space could be planned, according to the policy, and at the detailed design stage. (Ex. upper deck for pedestrians, lower deck for passengers or for shopping complex)

4) West Gate Building (Management Facilities)

West Gate Building ····· improved

— RC structured

— four floored

— 5,000 ㎡

The West Gate building is reconstructed of its main oncourse and atrium to be connected to the free passage. The space getting unnecessary, when part of the existing facilities here is shifted to Flow/Sales Facility portion of the station, could be used as storage etc. The other space will be utilized as it is today.

5) East Gate Building

East Gate Building ····· rebuilt

— RC structured

— four floored (one basement and three floors on gro
und)

— 3,000 ㎡

East Gate will be the main entry to the station in future. Outside the Gate, an approach deck is built to lead to the Sale/Flow Facilities through the free passage. Departing passangers will use this passage and the arriving passengers will use the ground level concourse. The flows of departing passengers and arriving passengers, along with the relevant flows of buses and taxi, will be thus separated.

The East Gate building itself is used as below mentioned;

1st Basement ····· machine equipment, substation and ticket storage rooms

Ground floor ····· passenger exit, maintenance staff's offices,

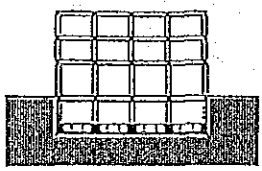
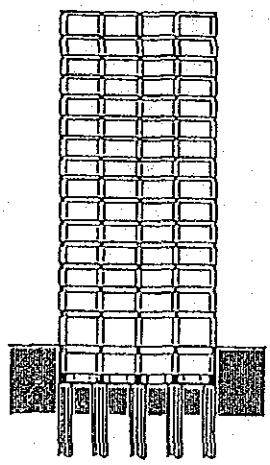
luggage acceptance

1st floor ..... passenger entry, shops

2nd floor ..... up-graded retiring room

It is important that a far sighted policy is decided by the top management whether the building should remain four storied, as planned in this study, or be a high rise building in future. The foundation of the East Gate building should be planned accordingly.

Conditions of estimating the investment cost for the present plan and a high-rise building plan.

Items	Present plan	Plan for a high-rise station
Scale	One floor basement, three stories	One floor basement, fifteen stories
Structure	Reinforced concrete construction	Steel-frame reinforced concrete construction
Foundation	Raft	In situ piled foundation
Conceptual profile		
Construction cost	33 Million Rs.	98 Million Rs.

The difference : 65 million Rs.

Provided that this East Gate Building should have fifteen stories (total floor area 48,000㎡) and a preemptive investment should be made in the foundation structures in advance, the additional construction cost would be approximately 65 million Rs.

For the future high-rise station building, it would be more economical to build a three floor basement.

According to a trial calculation, if a commercial building with fifteen stories and a three floor basement (total floor area 54,000 ㎡) is to be constructed, the additional investment required compared with the present plan would be approximately 700 million Rs.

6) Luggage handling facilities

For luggage handling, two underground passages crossing the tracks, will be built connecting the luggage acceptance office, sorting place, delivery place and the platforms. Lifts are installed connecting the underground passages to the platform level.

Slopes are constructed at both ends of each platform. Platform No.16 is assigned to connect the two underground passages.

6 - 3 - 3 Auxiliary Facilities in the Station Building

(1) Mechanical Facilities

Escalators, luggage lifts and air conditioning facilities are introduced to the new station building for the purpose of passenger services as well as for the smooth moving of passengers and luggages.

1) Escalator

Ascending and descending escalators are installed on both sides of the staircases leading to the overbridge concourse at the West and East Gates.

Type: reversible type for ascending and descenging passenger service

Inclination: 30 degrees from the horizontal

Rated Capacity: 9,000 persons per hour

Speed: 30 meters per minute

Nominal Width: 1,200 mm

Travel: ground floor to overbridge level, about 7 meters

2) Luggage Lift

The lifts will be installed to move luggage from underground passages to the platform level.

Type: luggage service lift

Load: 3,000 kg

Speed: 30 meters per minute

Travel: underground to platform level, about 6 meters

Stop: two stops

3) Air Conditioning Facilities

The air conditioning system will be designed according to the service purpose and running time required at respective rooms. Individual air handling units will be installed for a service block of the same category.

The design basis is as follows;

Outside Temperature and Humidity

	Dry bulb temp.	Wet bulb temp.	Relative humidity
Summer	43.3℃	23.9℃	20%
Monsoon Season	35.0℃	28.3℃	60%
Winter	7.2℃	5.0℃	70%

Inside Conditions to be maintained

	Dry bulb temp.	Wet bulb temp.	Relative humidity
Summer and Monsoon Season	24± 2 ℃	——	60%

Rooms to be airconditioned are waiting rooms, refreshment rooms, shops, offices in the overbridge concourse, and also shops and retiring rooms in the East Gate building.

The total area of airconditioning is estimated at 8,000 square meters, and the chiller to be installed should have a capacity of 600 refrigeration tons.

(2) Electrical Facilities

1) Substation

A substation for supplying the electric power for the lighting, air conditioners, escalators, luggage lifts and others will be installed in the new station building. The main specifications are as follows:

Capacity of Transformer	1500 KVA × 2 (one is spare)
Receiving Volatage	11 KV
Secondary Volatage	450 V
Emergency Generator	500 KVA

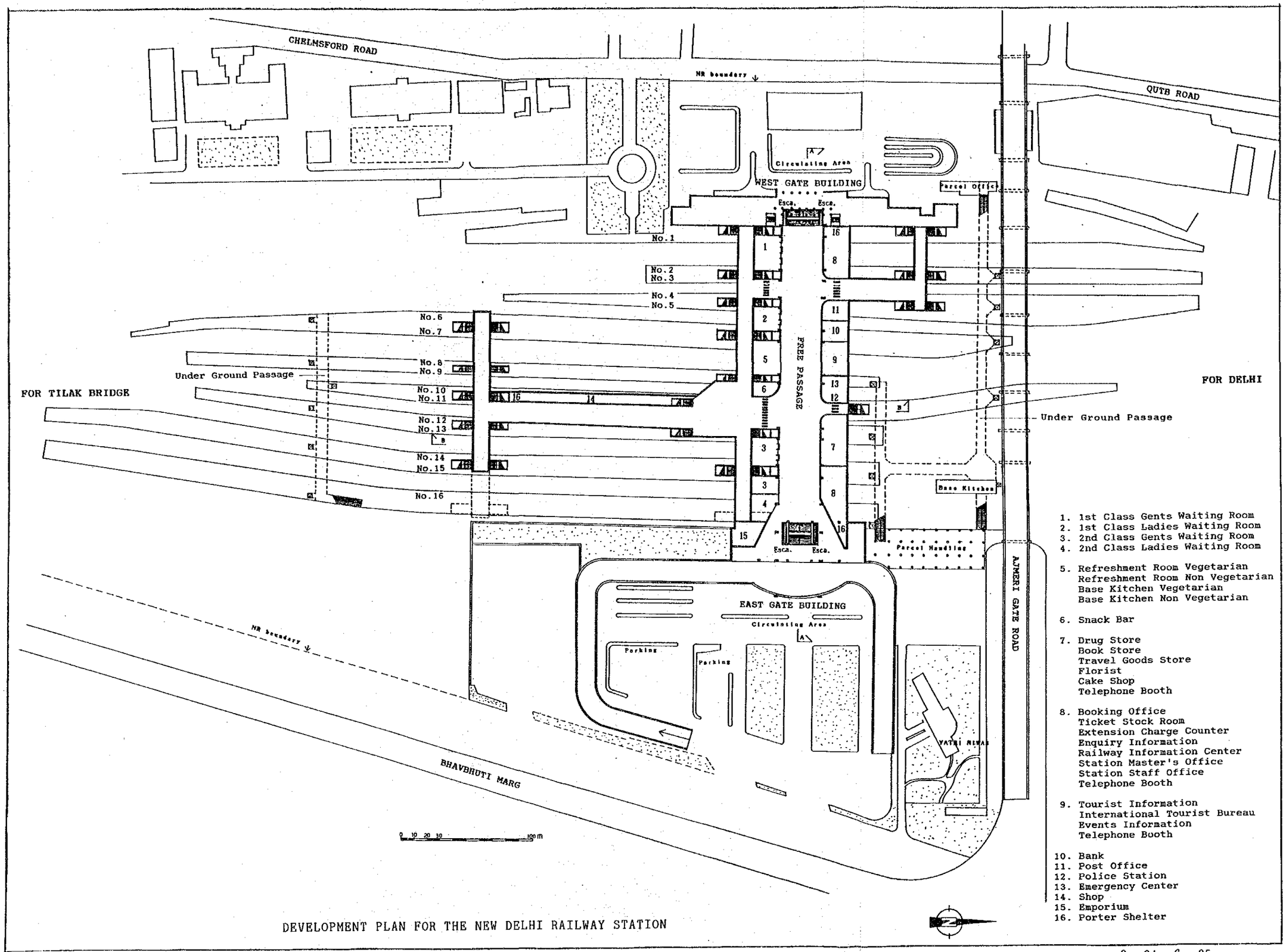
2) Power Distributing Line

The trank line of 415V, PVC cable will be provided underground or inside the building

3) Lighting Facilities

The high pressure sodium lamp and fluorescent lamp will be installed for the overbridge concourse, and the fluorescent lamp for passenger platforms. Illumination level is as follows:

Concourse and waiting rooms	200 Lx
Platforms and passages	100 Lx



1. 1st Class Gents Waiting Room
2. 1st Class Ladies Waiting Room
3. 2nd Class Gents Waiting Room
4. 2nd Class Ladies Waiting Room

5. Refreshment Room Vegetarian
   Refreshment Room Non Vegetarian
   Base Kitchen Vegetarian
   Base Kitchen Non Vegetarian

6. Snack Bar

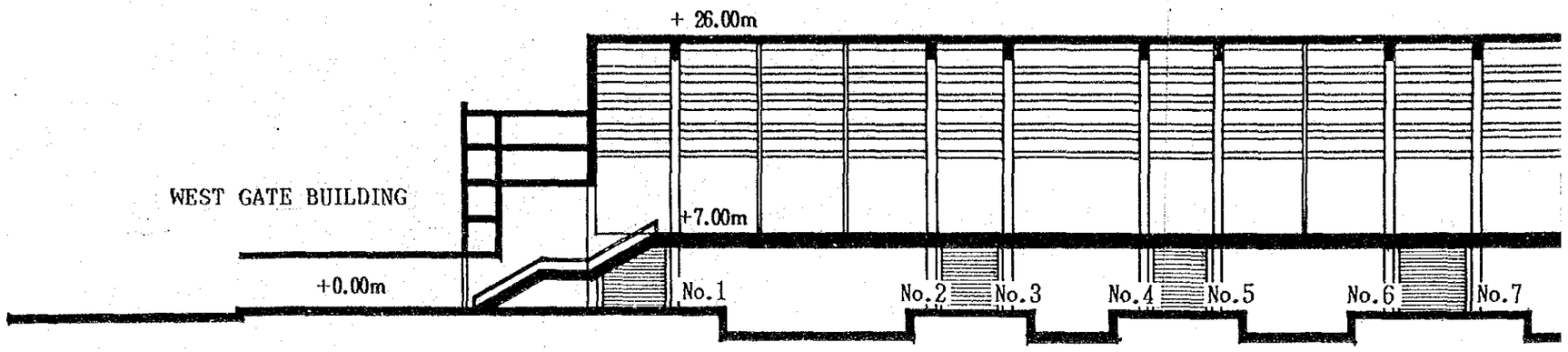
7. Drug Store
   Book Store
   Travel Goods Store
   Florist
   Cake Shop
   Telephone Booth

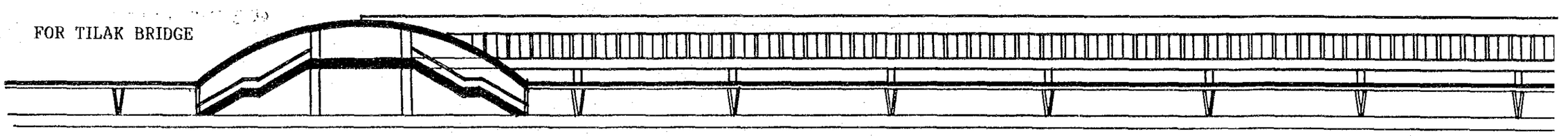
8. Booking Office
   Ticket Stock Room
   Extension Charge Counter
   Enquiry Information
   Railway Information Center
   Station Master's Office
   Station Staff Office
   Telephone Booth

9. Tourist Information
   International Tourist Bureau
   Events Information
   Telephone Booth

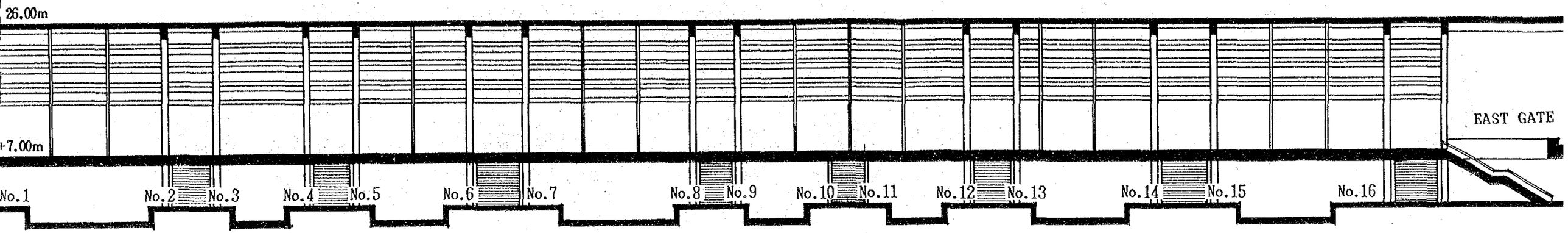
10. Bank
11. Post Office
12. Police Station
13. Emergency Center
14. Shop
15. Emporium
16. Porter Shelter

DEVELOPMENT PLAN FOR THE NEW DELHI RAILWAY STATION

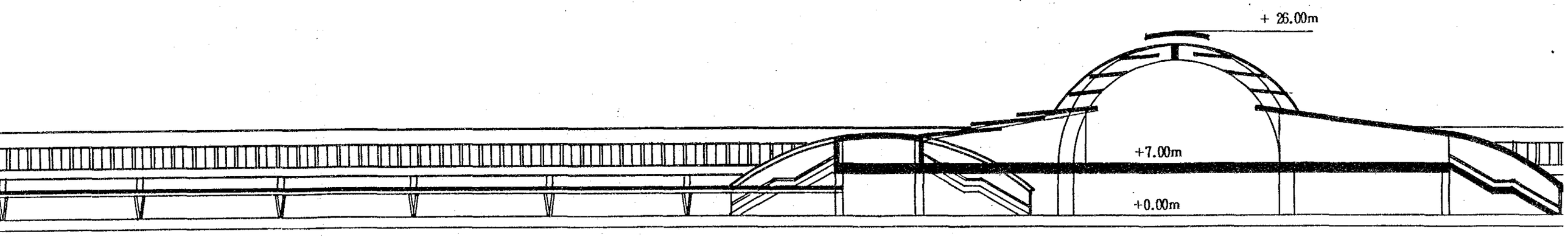

+ 26.00m
WEST GATE BUILDING
+7.00m
+0.00m
No.1
No.2
No.3
No.4
No.5
No.6
No.7


FOR TILAK BRIDGE

0 10 20 50 m.

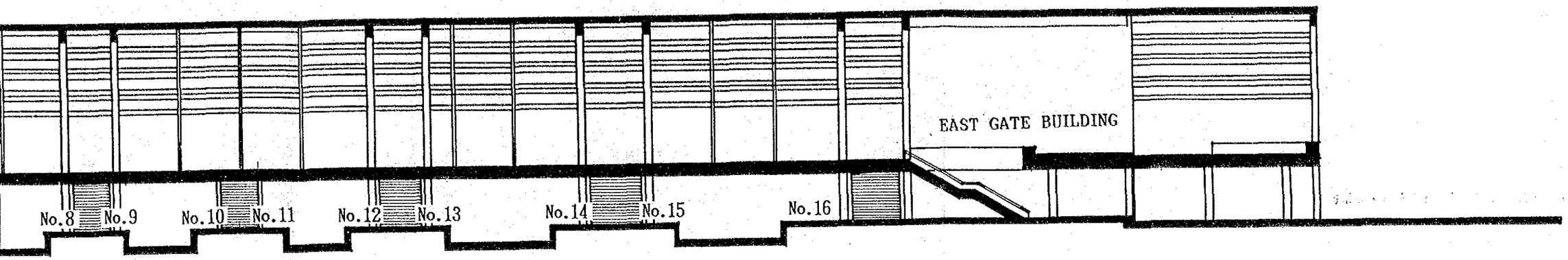


SECTION A. A

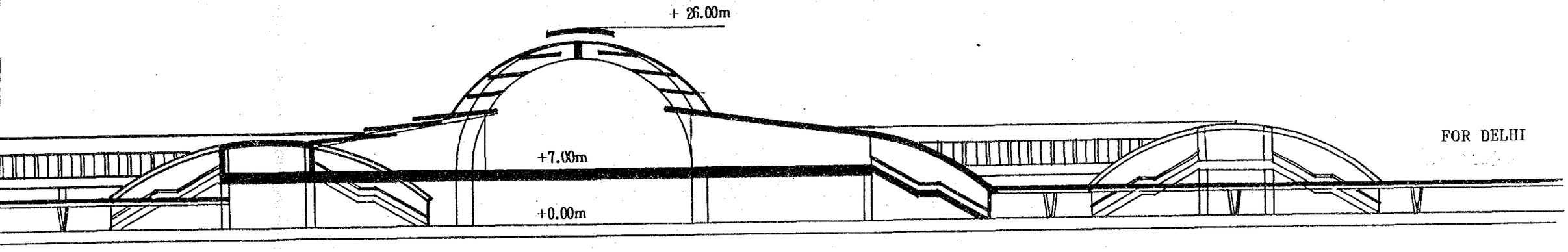


SECTION B. B

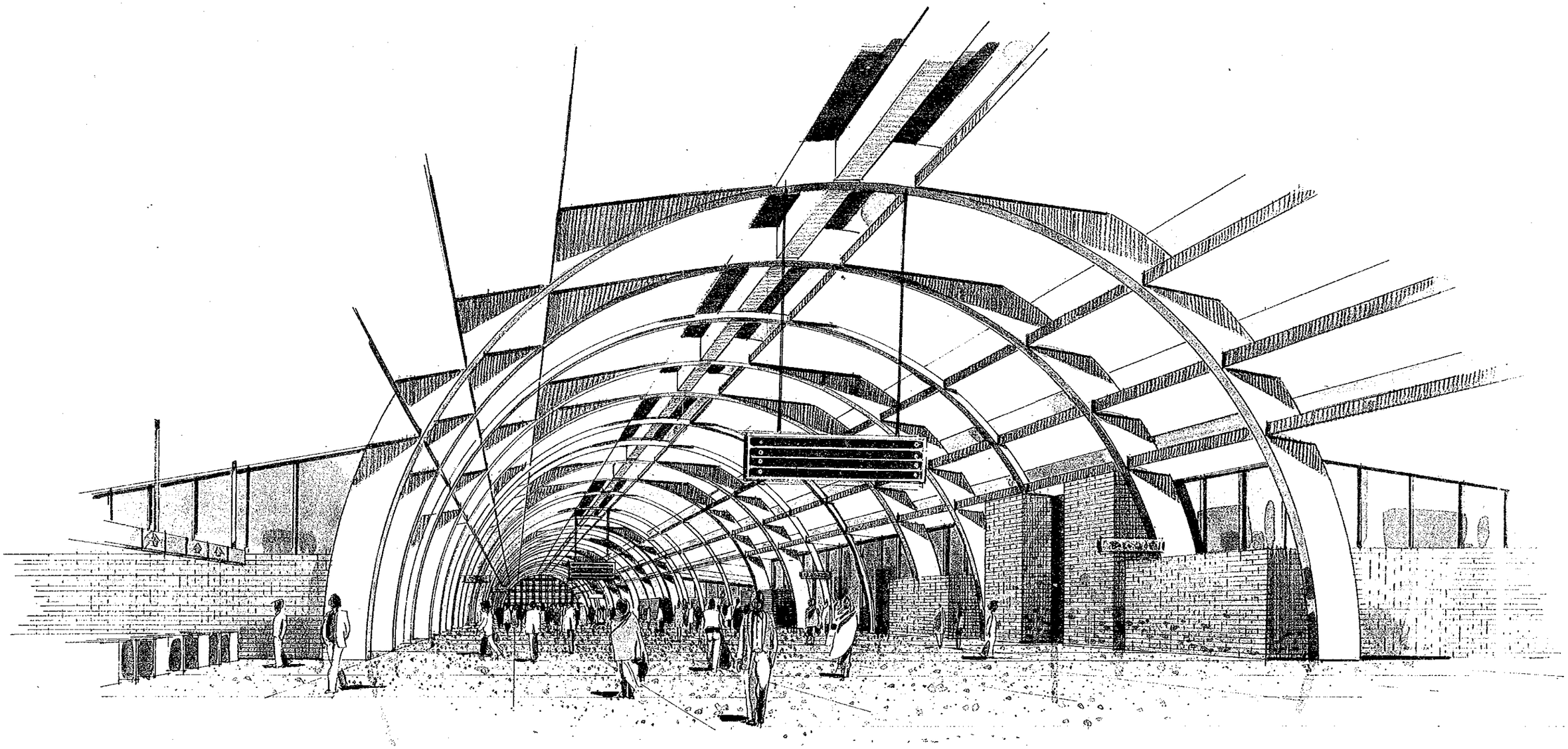
0 50 m.



SECTION A. A



SECTION B. B



DEVELOPMENT PLAN FOR THE NEW DELHI RAILWAY STATION

6 - 3 - 4 Station Plaza Planning

(1) General Policy

The station plaza is a place where a station junctions with the community for which the station is. Its functions are to distribute the detraining passengers to the community and collect the entraining passengers. To fully make it play its role, it must be furnished with a certain extent of space and installations. Thus they serve to smoothen the transfer between the railway and road modes.

A station plaza planner is generally requested to;

1) consider the public benefits and safety,
2) guarantee a good communication between the station building and the roads surrounding it,
3) refrain from building a road whose main traffic will pass it through, and
4) from building durable structures at the place where new railway facilities would be constructed.

(2) Present Status of the New Delhi Station Plaza

According to the result of the passenger flow survey, the number of access/egress persons using New Delhi Station is approximately 250,000 per day.

Among those persons, approximate 60% of them are utilizing the west entrancce at Paharganj side and the rest of them are utilizing the east entrance at Ajmeri Gate side.

As to a movement of the vehicles, according to the survey at the peak time, the above-mentioned ratio gets inverted, namely, approximately 60% of them are utilizing the east entrance. As to the number of vehicles at the east entrance, access vehicles are approximately 2000 during the peak three hours. This figure is not so large, but low speed traffic such as horse wagons, rickshaws etc occupy relatively a larger part of them.

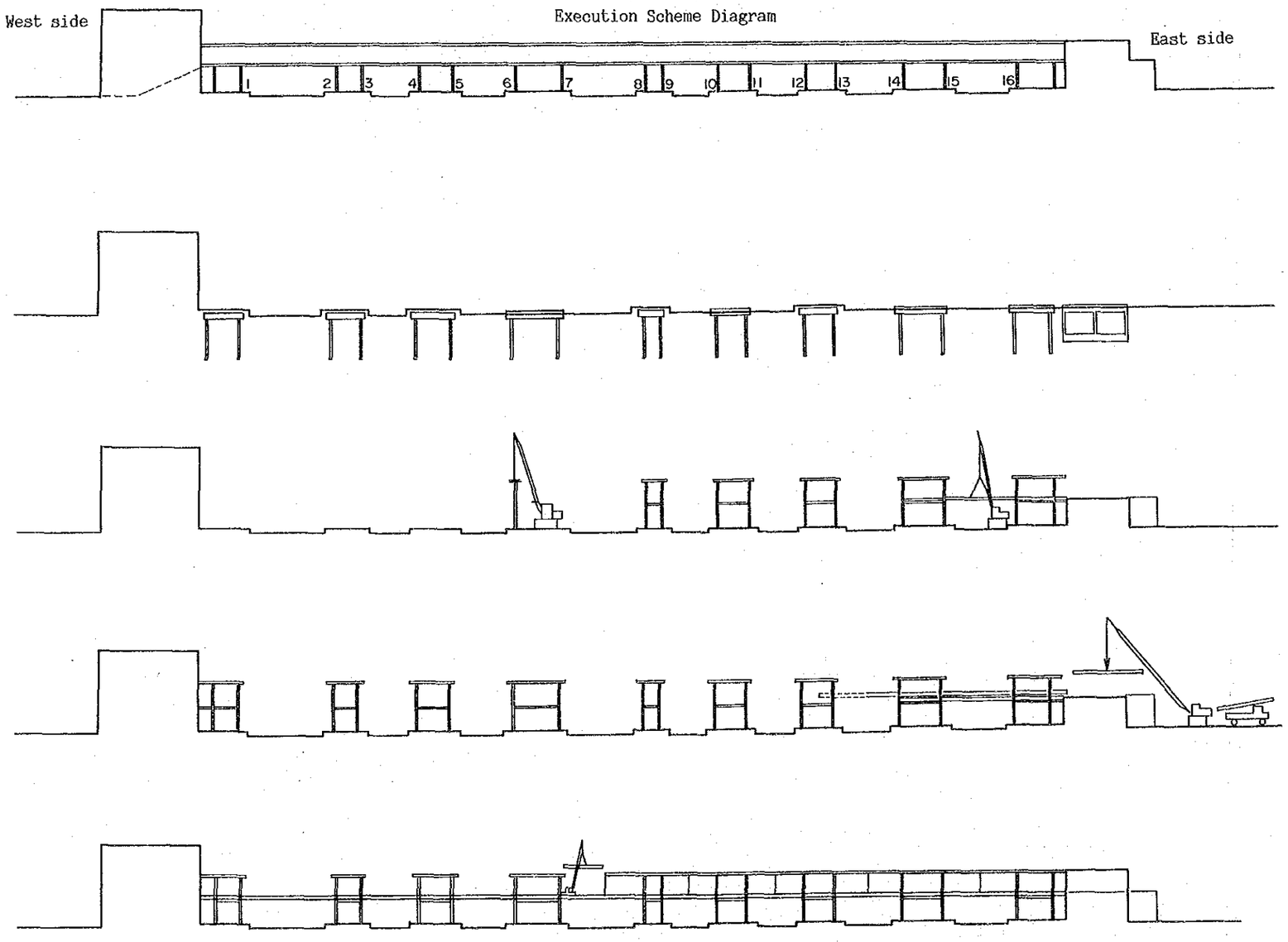
(3) Improvement Plan

The west side of the station has a plaza of approximately 20,000 square meters (250m long × 80m wide), with a temple and its compound at the western edge of the plaza, making access/egress to the station by bus difficult. On the other hand, the east side of the station has a plaza that is extensive and well furnished. It is assumed that this side of the station will be utilized more by passengers in the future, as it is nearer to the Ring Road. By building exclusive platforms for exclusive use for buses and building a double-deck structure for car access/egress, as well as by laying out the facilities providing a good balance among all the transport modes, the East Gate plaza will function better than West Gate. It will be better suited as the gateway to Delhi Central.

6 – 3 – 5　Execution Planning

Before the execution of the over-track building, a sufficient coordination must be made with the relevant train operation schedules and the yard work schedules, it is after this coordination that the detailed execution plan could be prepared.　Supervision and safety control measures should also be well-prepared.

Following is an example of the said execution plan.



SECTION

STEP 1
Set the piled foundation at each platform. Since the foundation piles are set near the line operated, it is appropriate to execute the said work by using the in-situ piles taking the influence to the facilities in yard into account.

STEP 2
Set the rigid steel-frame structure at each platform, to assemble the first floor beam at the east side and to construct the working stage.　As to the steel-frame, taking the weight and the workability into account, it is appropriate to adopt assembling beams by using shape steel.

STEP 3
Build the first floor beams from the east side stage to the No.1 platform by the delivery method and to construct the first floor.　As to the first floor, it is difficult to construct it by the in-situ concrete. Therefore, it is appropriate to construct it by the precast concrete slab.

STEP 4
Raise the jib crane on the first floor and set up the first-floor pillars and roof beams. After the completion of such equipment works as piping, wiring and so on, architectural finishing works are carried out.

6 - 4 Passenger Information System

6 - 4 - 1 Present Status and Problems

As passengers increase in number their needs become more complicated and the needs for passenger information facilities arise. It is necessary, as a part of the New Delhi Station modernization plan, to drastically improve the present information facilities. It is necessary to see whether or not there are appropriate facilities for passengers changing trains or transferring to other modes of transport, and to see whether or not sufficient information is being provided to them at the right time and at the right place. In concrete terms, the problems areas detected at New Delhi Station are as listed below.

1) It is difficult to distinguish signs for passageways, etc., due to poor lighting.
2) There are not enough guide maps and signs and they are not easy to understand. This results in station users relying solely on an information desk.
3) Signs for passengers getting on and off trains are not properly located.
4) Although speakers, TVs, electronic boards, etc., are used, the content of the announcement is not appropreate, the sound level is too low or too high. The location of the speakers and boards are not good and coordination of these devices are not proper.

At present, there are many face-to-face and telephone enquiries from train users to Inquiry Office in New Delhi Station and General Inquiry Office, due to frequent train rescheduling and delays. For this reason, especially at New Delhi, Delhi and H.Nizamuddin, inquiry offices regularly collect the necessary information from the control center. At an average, there are 5000 calls per day to the General Inquiry Office, and an automatic telephone answering system has recently been introduced to handle them.

On the other hand, the management of New Delhi Station announces and

broadcasts, via a speaker system and a closed-circuit television system, the information concerning train destinations, platform numbers, delays in arrivals, etc. The broadcasting is made from a signal cabin, and the equipment is insufficient. Movable electrical indicators are planned to be installed at main concourse, as part of the scheduled introduction of a CTC system.

For the seat reservation information, TVs and indication boards at reservation centers are used. In the future, it is planned to introduce simple seat reservation indicators at relevant stations, etc., using an independent circuit.
The present flow of passenger information, including the system under construction, is as shown in Fig.6.4.1.

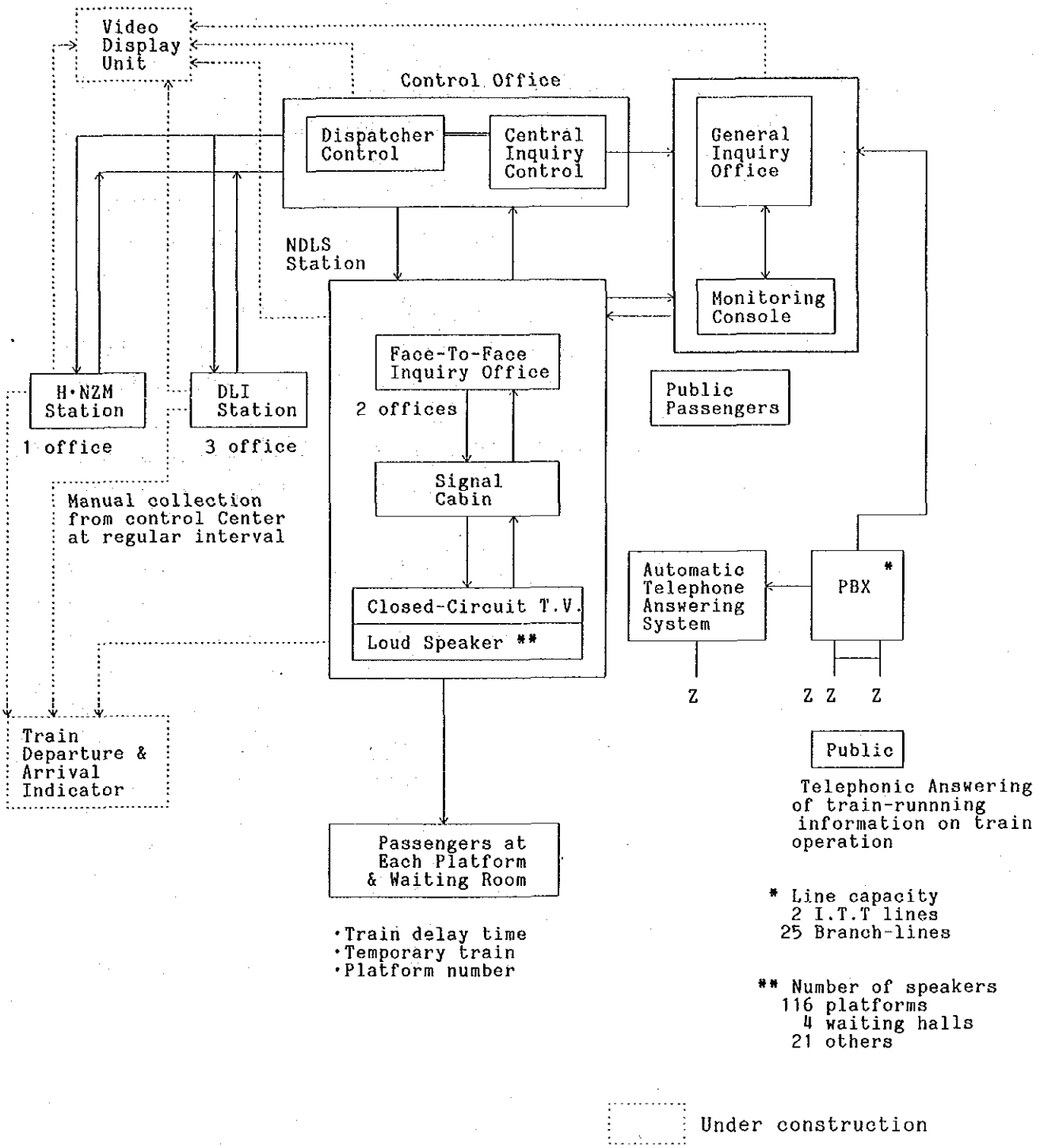


Fig.6.4.1 Present Passenger Information Flow at New Delhi Station
(Including the system under construction)

6 - 4 - 2 Fundamental Policy on Improvement Plan

(1) Basic information processing system

When constructing a passenger information system, emphasis should be put on the following three elements: (See Fig.6.4.2-1)

— input (information collected by management),
— processing (information made understandable for passengers),
— output (provision of processed information to passengers).

The process flow is as shown below in the block diagram.

a) The passenger information system is to be linked with the train operation system under construction, so that the information on train operation could be always recorded.

b) The passenger information facilities is to be laid out so as to conform to the flow of train operation information and to provide necessary and adequate information to passengers.

c) When a train is operating on schedule, the selection of the method and place of indication shall be the main thing. When a train is not operating on schedule, the way information should best be conveyed for both normal and abnormal situation's systematically is grappled with since the content of such information is extremely important for passengers.

d) Since indication equipment (train departure indicator, etc.) is or public use, it should be easy to see and promote smooth passenger flow.

e) Aesthetics and cost-effectiveness should be considered in the design of new technology to be introduced.

f) Face to face information service to passengers will be provided information center.

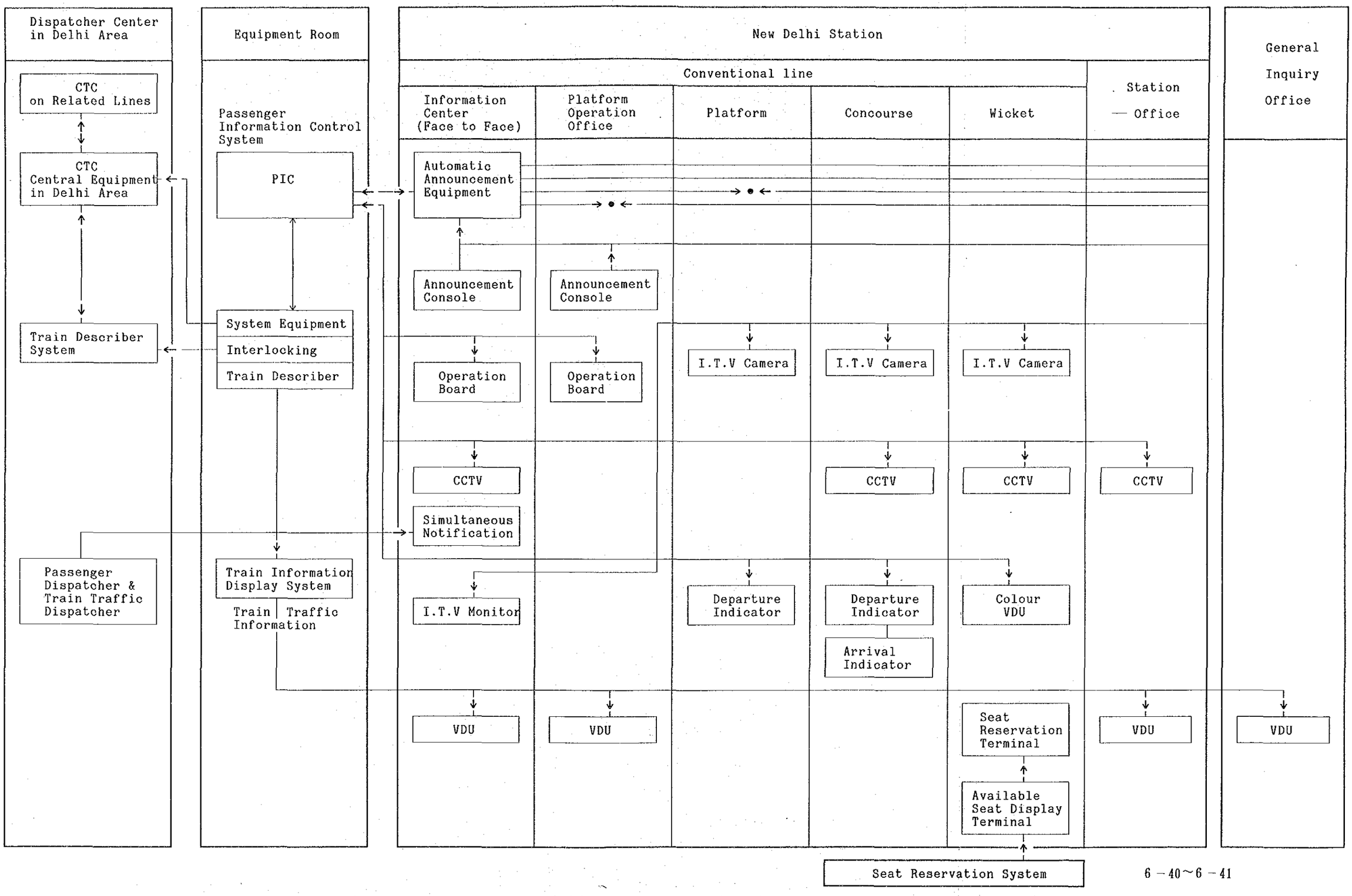
Collection of Information	Information System for Guiding Passengers	Providing Information
I n p u t	**S y s t e m**	**O u t p u t**
Basic information, Information on abnormalities, Train numbers, Train cancellations, Train positions, Delays, Platforms, Connections, Changes in the seat-reservation system and track, etc.	Hardware and Software Central equipment, Information indicators transmission and receiving panels, Announcements, Monitoring panels, Operation panels, Monitoring, System administration, Communication control, Train schedules, Information handling, Train tracing, Handling information on abnormalities	Places : Streets, Stations, On-board trains Conditions(normal, abnormal) Kinds Train numbers Timing Platforms Accident information Delays Connections

Fig. 6.4.2-1 Systematic Diagram on Passenger Information Flow

(2) Application in New Delhi Station

The present actual train operation in the Delhi area is often late to the schedules. Accurate train operation information (eg.,train arrival/departure time, arrival/departure platforms) is requested. The efficient passenger information system in New Delhi Station, will aim at the aboves. (See Fig. 6.4.2-2 and Fig. 6.4.2-3)

Fig 6.4.2-2 Passenger Information System in New Delhi Station



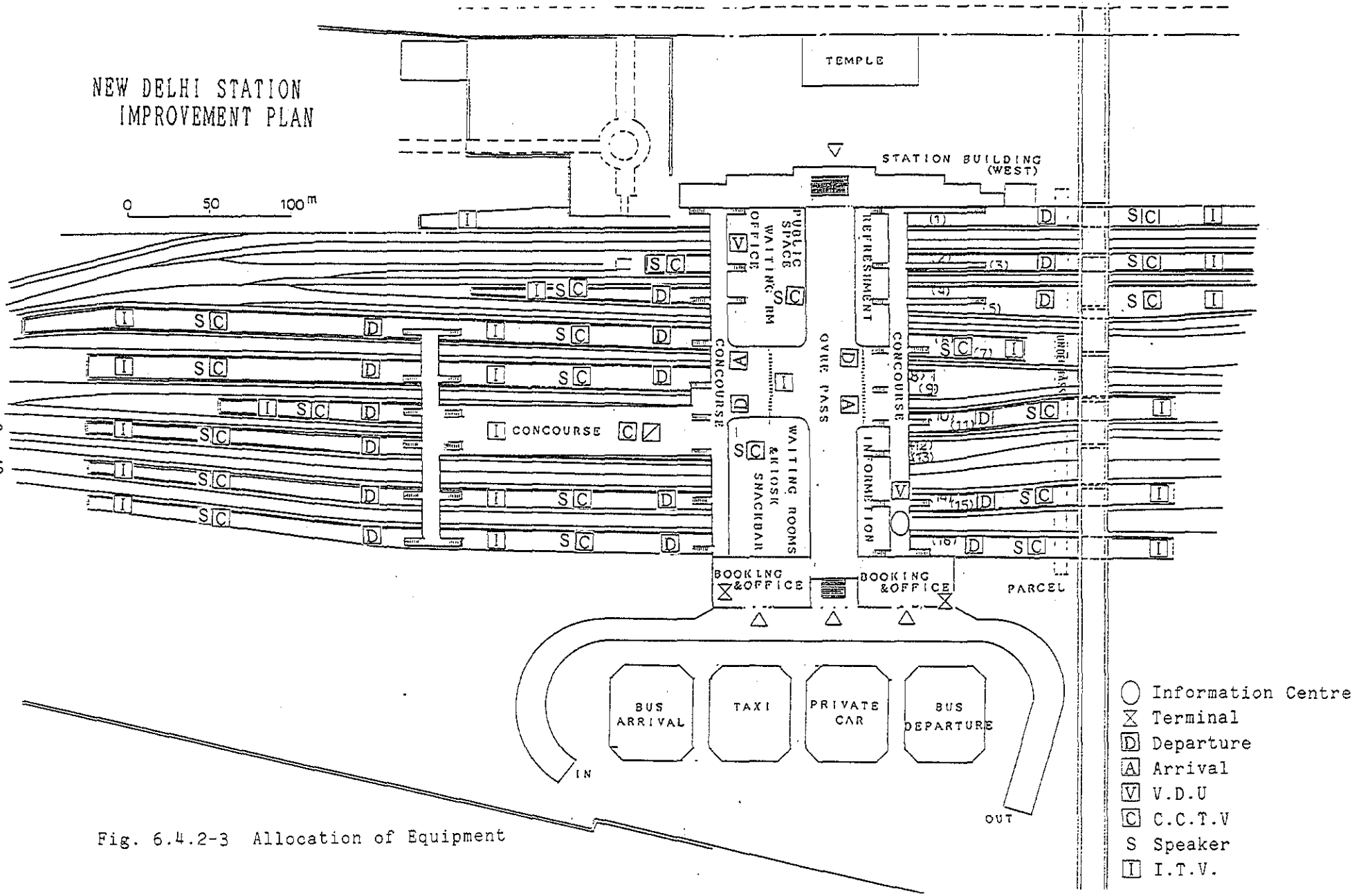


Fig. 6.4.2-3 Allocation of Equipment